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SEX DETERMINATION

A treatise on the control of sex in generation

by

Excell. Dr. Ed. v. Seligson.

(wirklicher Staatsrath und Ritter).

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Preface.

The question as to the possibility of procreating boys or girls, according to choice, is so large and important and one of so great signifiance, that it is not to be wondered, at that it has occupied the closest attention of scholars and scientists from the earliest times. When we reflect, that in those families, in which only girls or only boys are born, the desire for the birth of a child of the other sex is quite intelligible and excusable, since in not a few cases the whole happiness of a family depends on the fulfilment of this wish; and when we further consider, that it cannot be a matter of indifference to a sovereign, whether the first-born child is a male or a female, so much more important is the solution of this problem from sociological and political relations. Obviously the lives of men are exposed to greater dangers through war, vocation, etc. than those of women, and accordingly nature in her wisdom seems to some to strive under all circumstances to preserve the relative numerical ratio of the two sexes, in that she produces more males than females in the proportion of 106 : 100.

This view of a teleological process in nature is a mistaken one, or it has a limited foundation, which applies only up to a certain age. When we investigate the proportion of men to women, e. g. between the ages of 20—25 years, we see that almost always and every where the number

of women exceeds that of the men. Thus we find from the last census for the period between the ages of 20—25 years the following proportions:

in Great Britain	1046	women	to	1000	men
» Germany . . .	1037	»	»	1000	»
» Norway . . .	1036	»	»	1000	»
» France	1008	»	»	1000	»

But when we come to Belgium, we find a very slight preponderance of males over females, which however does not reach the general ratio (although it approaches it) for there are

in Belgium	999	women	to	1000	men
» Italy . .	998	»	»	1000	»

and in consequence of the great immigration into the United States of America

978 women to 1000 men [1]).

From these figures we see, that the excess of women is a rather large one, and we must not forget, that at this period (between 20—25) the consequences of the more dangerous callings of men first arise, and accordingly the excess of women over men must become still greater with every period of years. If it lay in the design of nature to effect a compensation for this, then the proportion of male to female births would have to be 108 or 110 : 100.

Such a comparison in itself shows, how very important it is, to solve the problem of the determination of sex, and although in the course of time numerous theories were propounded, little progress was made in answering this question, because all the theories rested more or less on a purely statistical basis, and yet possessed absolutely no scientific, and

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[1]) Hellstenius, Studier etc. Stockholm 1874.

still less practical, value. The only proper way, which should have been taken to decide this question, viz. experiments on animals, was always overlooked. It is true *Henke*, a sexton in Hildesheim, had a hundred years ago carried out a series of such experiments, and in them obtained very extraordinary and unexpected results, but he lacked the weight of authority to have his opinions accepted, and the result was, that he soon passed into oblivion in ridicule and contempt. He just shared the lot of many laymen, who have made a big discovery, but never won any recognition for it.

Without being in the slightest aware of the existence of a *Henke* or his experiments, I myself came by a purely empirical course, to take a part in the investigation of this question. The observation of over a hundred families with more than 500 children showed me, that the sex of the future child may be determined beforehand and the production of either sex according to choice is not nearly so difficult, as is generally supposed. I was unable, however to conceive some anatomical-physiological law, which would explain the method, which I had discovered, because I laboured under the curse of preconceived notions and theories, which I had embraced from the earliest days of my studies and in later life, and I could not free myself from them, until I finally said to myself that, what great investigators before me had failed to discover, I certainly would not find out. I gave up the whole speculation and satisfied myself with the facts of the practical results which I had already obtained.

Six years ago when I was engaged in writing my treatise on Gout [1]). I had recourse to *Hippocrates*, whom I had not read for nearly thirty years, and there came upon

[1]) Ueber die Gicht. Moskau 1893.

some aphorisms, which might serve me as a starting point for a theory of the origin of sex. I had been hindered by a death in my family, by professional duties and personal indisposition from beginning the work, and it was only later that I was enabled to enter upon the solution of this to me very interesting question. Whether I have succeeded or not, I shall leave others to decide; yet I have the conviction, that my theory is correct.

The proofs, which I have consist of experiments which on the whole agree so closely with those made by *Henke*, that it must appear quite extraordinary and is only to be explained in this way, that we have both started upon one and the same principle. Although I had conceived my experiments quite independently of *Henke*, yet the credit of priority is due to him, and I content myself with the consciousness of having wrested from oblivion a truth long ago proclaimed and brought it forward for further discussion.

Besides experiments on animals which I myself have made, and which were to be carried out under the direction of Professor Guttmann at the Veterinary Institute in Jurgew (Dorpat), I have made use of the results, which operations in cases of tubal pregnancy give in proof of the correctness of the Ovarian Theory of Hippocrates, since the discovery of always the same sex in the same fallopian tube must be decisive, although with experiments on animals the question may be raised, whether we are entitled to apply to human beings everything, that holds good with the lower animals. As a matter of fact *A. Gönner* showed, that the experiments, which he made upon rabbits by no means agree with my theory and to this point I will refer again in the course of this treatise. I may here just point out, that for the solution of the problem under our consideration one must in the future employ only *uniparous* animals (as the

horse, ox, sheep) and not *litter-bearing* animals (as rabbits dogs, swine).

The first work, which I met with on working out this problem, was that of Dr. H. Janke, «Die willkürliche Hervorbringung des Geschlechts bei Mensch und Haustieren, Stuttgart (no date)». Although my own views on the origin of the sexes are quite different from Janke's, and although I have arrived at results quite different from his, I nevertheless consider it my duty to acknowledge here, that I owed it solely and entirely to his book, that I have succeeded in a relatively short time in working up the extraordinarily large literature, which deals with this subject; I did not require to hunt first from one book to the other, for in his work I found the literature, and especially the part, that treats of the statistical theories, exhaustively and completely compiled. At the same time I must here declare, that the book of *Janke* is in every respect to be regarded as a profoundly scientific work, which may be most warmly recommended to every one, who is interested in the literature on the determination of sex.

Since this treatise is intended for the general public as well as for the medical profession, I have considered it advisable to preface this work with a short explanation of the process of Reproduction in popular language, so far as this is absolutely necessary for the understanding of the various theories.

In conclusion, I come to physicians and to the general public with the earnest request, that they will send to me observations from their own families, or from those known to them by letter or post-card, signed or unsigned, no matter whether these observations should agree with my views and the method I have proposed, or not. Reports of those cases would be of specially great interest, in which there were exclusively boys or exclusively girls in the fa-

milies. Should in this way a large amount of material be in time placed at my disposal, I shall not fail to publish the same in accordance with the truth, whether it turn out to my favour or not.

Dr. Ed. v. Seligson.

Moscow: Jan. 1901.
Armiansky pereulok, house
Konstantinoff.

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Reproduction [1]).

It is of course impossible, to give an exhaustive account of Reproduction here, yet I consider a short general summary absolutely necessary for the understanding of the various theories, that have been propounded on the origin of sex, since otherwise to the laity much might be unintelligible. I will therefore set forth only the most essential facts about the Ovum, Semen, Copulation etc.

It may be laid down as an absolute rule, applying to the most highly organised animals, as well as to the lowest, that the formation of new individuals takes place *only* by the method of natural Reproduction. The idea of a spontaneous generation (Generatio spontanea seu aequivoca), which can be neither definitely proved, nor absolutely disproved, does not come into further consideration here.

Two chief forms of Reproduction are distinguished: the one is the *Sexual*, or *Bisexual*, the other the *Non-sexual*.

In Sexual Reproduction the ovum or female germcell is the element intended for transformation into a new organism, and is prepared in organs set apart solely for this purpose, the female germinal glands, or Ovaries. But in order that this germcell may undergo and complete that series of changes the product of which is a new individual, it requires the material cooperation of a second element, the Spermatozoon.

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1) From Wagner, Funke, Landois, and Dict. Encyclop. de Sc. medic. (Articles: Génération, oeuf, semence etc.).

which is likewise prepared in special organs, the male germinal glands, or Testicles.

The act of union, or passage of the spermatozoon into the ovum, is denoted by the term Fertilisation [Reproduction by fertilised ova] in contradistinction to the rare exceptions, where even unfertilised ova pass independently through the whole series of developmental changes and are evolved into living organisms [Parthenogenesis]. We must however bear in mind, that Parthenogenesis is an exceptional phenomenon, confined to only a few genera, and is present in these genera not as the sole method of propagation, but always in bi-sexual animals side by side with bi-sexual reproduction, and moreover is of such a nature, as a rule at least that, the brood produced by Parthenogenesis belongs without exception to only one sex, either the male as in bees or the female as in Psychides, while for the production of progeny of the other sex bisexual reproduction takes place.

Non-sexual Reproduction is characterised by the fact, that there is no distinct product of the parent organism, made specially for reproduction, that grows into a new individual, but any part which belongs to that organism and has its function in it may do so; and further, that this part does not require the contact of a second Element, formed exclusively for this purpose, on which it must depend in order to complete its metamorphosis into a new being. Under this Form we distinguish Reproduction (1) by Division and (2) by Budding or Gemmation.

The Ovum.

The ovum in Mammals and in Man (discovered by C. E. v. Baer in 1827) is an exceedingly small spherical vesicle, which measures on an average only 0,2 mm. in diameter.

Its outer wall consists of a thick membrane, which

manifests itself under the microscope as a broad clear border (Zona pellucida). This spherule is filled with a viscid opaque fluid, the vitellus or yolk. In the interior of the yolk, and situated usually eccentrically, is a small clear vesicle of 0,025,—0,030 mm diameter, the germinal vesicle (discovered by Purkinje), which at a spot in its interior contains a dark rounded nucleolus, of about 0,005 mm diam. the so called germinal Spot. (discovered by Wagner). In rare cases there are two or even several nucleoli in one germinal vesicle.

The seat of formation of the ovum is in the Vertebrates generally in closed follicles *(Graafian follicles)*, which in Mammals are imbedded in the stroma of the ovary in their immature condition, but when mature project only slightly above the surface.

The *Ovaries*, two in number, are situated in the pelvis near the uterus; they are oval in shape (4 cm. long, 2·2 cm. broad, and 1·3 cm. thick), and contain even at the time of birth not only numerous follicles, which though small are nevertheless in all parts developed, but even Ova in some of these. (C. Carus, Discovery of the first ovum or Vitelline Sac, etc. Müllers Archives 1837, p. 442). The ovaries, in sexually mature women therefore, show follicles in all possible stages, the youngest deeply imbedded in the stroma, the riper lying nearer the surface, and the most mature bulging out from it.

Although the ovary contains only 12—20 larger follicles, yet according to Barry a much larger number of them is present in an undeveloped condition. According to *Henle* the number of ova in the ovary of an eight year old girl amounts to about 36000, while *Kölliker* on the other hand estimates the normal number at 30—100, so that very probably besides the maturation of follicles and ova present a formation of new ones also takes place.

Menstruation and Heat.

The first maturation and discharge of an ovum from its follicle marks the beginning of Puberty, and this varies within certain limits: in which *climate and race* play the most important part, while individual variations such as *station*, *mode of life*, *and physique* on the other hand play only a small; in our regions the first menstruation occurs in the female between the 14-th and 16-th year. From this period onwards at shorter or longer intervals the discharge of ova, prepared in the reproductive organs, takes place spontaneously i. e. without any assistance whatever from the male (Copulation). According to *Boismont* and *Schweig* the interval amounts on an average to $27^1/_3$ days.

Although this periodic discharge of ova in the majority of animals was a fact long ago known by the name of Heat it was only in 1844, that *Bischoff* showed, that in the same way also a spontaneous discharge of ova takes place in human beings at regular intervals and that in all probability with them too it is only those spontaneously discharged ova, that are fertilised by copulation. Menstruation is accordingly nothing more than a condition, analogous to the period of heat in the lower animals, and yet these two phenomena are by no means identical. Thus, when the female is kept away from conception, the symptoms of heat disappear, to return after a short time, and in the ape, horse, and cow these intervals amount to 4 weeks, so that this period of heat may be taken as the equivalent of menstruation [1]). The two processes on the other hand differ in this, that the period of uterine secretion and haemorrhage in animals is that in which copulation takes place, while in human beings the time of the men-

[1]) Hensen: Physiologie der Zeugung. Leipzig. 1884.

strual flow is in the vast majority of cases that, in which the wife, and certainly the husband, is repelled from rather than excited towards sexual intercourse; indeed, during the menstrual discharge the sexual appetite is diminished, and coitus as a rule does not occur [1]). Of course it cannot be denied, that increased sexual appetite in women during menstruation is not very infrequent, and indeed in the *Vedas* it is remarked, that women have sexual desire during menstruation. Further, there is this difference, that in man a single coitus may bring about impregnation *at any time*, while with the lower animals copulation will produce conception only at the time of the periodic maturation of the ova. This is of course not always the case and very frequently a single coitus might at certain periods also produce no result.

While in the lower animals activity of the reproductive organs in the male sets in only at seasons, and indeed exactly at the same seasons, in which the period of heat appears in the female, and moreover both sexes are impelled by instinct, to provide for the union of the developed and discharged elements of reproduction under suitable conditions, we see, that in man the male shows no interruption in the activity of his reproductive glands by periods of rest, and has no periodic «heat» coinciding in time with menstruation in the female. A man is therefore capable of bringing about pregnancy at any time of day, or season, of the year, just as a woman may in spite of her periodic discharges become pregnant after coitus at any time, not only during menstruation, but indeed midway between two periods. There is therefore in man no period of heat.

The discharge of an ovum is accompanied by haemor-

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[1]) Strassmann: Archiv für Gynekologie. 1896. Pt. I, p. 170.

rhage from the uterine mucous membrane and a consequent discharge of blood from the external genitals, yet one must not think, that menstruation is solely dependent on the maturation and bursting of a graafian follicle, for menstruation not infrequently passes without ovulation, and again the maturation and rupture of an ovum may occur without any menstrual flow.

Ten days before the appearance of the menses the mucous membrane of the uterus begins to expand (Kundrat and Engelmann), it becomes gradually thicker, more succulent, as well as softer and redder, and there is an increase of the cells. The glands increase in length, the network of vessels is extended, and the surface of the mucous membrane goes into numerous folds. The cavity of the uterus becomes smaller and smaller, the opposite surfaces approaching each other, till they come in contact. The increase of the mucous membrane and the glands is therefore the *first stage* of menstruation. In the second, *the stage of bleeding*, extravasations appear in the mucous membrane, individual epithelial cells and even small patches of the membrane are shed, and the blood flows towards the exterior. After the haemorrhage ceases *the third stage* begins, and in it the mucous membrane is anaemic and thin, the vessels and glands contract, the small losses in the epithelium are speedily replaced, and in this condition the inner surface of the uterus remains till 10 days before the next period when the swelling and expansion begin anew (Strassmann).

I have described this process in somewhat great detail in order to make it more intelligible to the laity, that *the period before the onset of menstruation* is really the most unfavourable for the passage of spermatozoa into the uterus, since its mucous membrane is swollen, the cavity thereby contracted, and the opposite surfaces are lying

against each other, while on the other hand the passage of the spermatozoa is much facilitated *after the menstrual flow*, because then the cavity of the uterus has become larger by a decrease in the thickness of its mucous membrane.

The duration of menstruation varies in different individuals, but in most women it lasts some 4—5 days, and more rarely up to 8 days. During a period processes probably go on in the fallopian tube similar to those in the uterus, only to a much less extent. (Strassmann).

The discharge of an ovum comes about in this way, that a mature follicle becomes more and more distended by the increased secretion of the fluids, occupying its interior, bursts always at the pole of the part which projects beyond the surface, when the fluid contents and the ovum along with them gradually well up at the site of rupture on to the surface of the ovary where they pass into the tube prepared for its reception. But it may also happen that the ovum on its discharge from its follicle gets into the abdominal cavity beyond the sphere of action of the funnel-shaped end of the tube, and from this some would deduce the possibility of a primary abdominal pregnancy.

The emptied follicle collapses with closure of the small rupture, and undergoes fatty degeneration and atrophy, until at last nothing more remains of the entire follicle but solitary pigment-granules. The emptied follicle *(Corpus luteum)* attains only a limited size if pregnancy does not take place, and after an interval of 1 or 2 months, or even sooner, shrivels up till only a small remainder is left. If however an ovum is impregnated, the follicle from which it came, then becomes three or four times as large, going on increasing till it reaches its highest development in 4—6 months, and measuring at the time of birth 6—

10 mm. in diameter, after which it atrophies at a correspondingly slow rate. The cause of the considerable growth of the corpus luteum lies in the increased activity of the whole generative system during pregnancy; *the corpora lutea that are much developed in pregnancy retain during the entire gestation almost the same large dimensions, and accordingly during this period one can tell with certainty, from which ovary the impregnated ovum has come.*

In women the ovary yields every four weeks for 30—35 years an ovum capable of development, and yet in a large number of individuals not one of these ova becomes developed, while in others only 1—6. While a family of 12 children is in foreign countries of the greatest rarity, there are in the Moscow Lying—in Hospital yearly about 100 women, that have born from 10—19 children; indeed in 1877 their number reached 146. Of 5851 multiparae there were 15, that were confined for the 15-th time, while there was one case each of women, that were delivered for the 18-th and 19-th time. I will speak of extreme fertility in individual women again under multiple pregnancy.

The question now comes, as to how the ovum, when discharged from the follicle reaches the uterus, since as a matter of fact in all Vertebrates, with the exception of the Bony Fish, the peculiar condition occurs, a condition not seen in any other gland, that the duct leading from the ovary, the fallopian tube, has no anatomical communication with it, but begins with a free orifice, more or less distant from it.

In some animals it is an established fact, that the ovum after its exit from the follicle must, in order to reach the tube, traverse the free Abdominal Cavity for a considerable distance, i. e. in those animals, in which the end of the tube is immovably fixed at some distance from the ovary. How under these circumstances it is ensured, that the

ovum keeps on the right way, and what forces move and guide it over this free passage, has not been definithly ascertained. In those animals on the other hand (as in Man), in which the end of the tube is freely movable, it has been proved from direct observation, that at the moment of discharge of the ovum the orifice of the tube is laid against the ovary, and indeed regularly embraces the ripe follicle, which is preparing to burst, in such a way, that the issuing ovum must necessarily go into it.

Kiwisch and Sommer have established from post mortems, that the orifice of the fallopian tube lies not only during the period of heat or menstruation, but at all times near to the ovary, or indeed over it.

If the ovum has once reached the fallopian tube, it is then carried forwards to the uterus (in the opinion of many), by the action of the ciliated epithelium of the tube, and the streams of fluid, which it sets up, and Lode [1]) considers the ciliary movement as the only operating element and expresses the opinion, that the period of heat has only an accelerating influence on the rapidity of this motion. A certain proof, that the action of the cilia *alone* can promote the transmission of the ova, is afforded by the observation by *Hensen* of the presence of numerous unimpregnated ova in the closed-up tube of a rabbit. Other observers are of opinion, that the ovum on its entrance into the tube is carried forward by the contraction of its muscular coat. It is most highly probable, that both these are factors in the transmission of the ovum.

As regards the time, required by the ovum to pass through the tube, there are numerous reliable observations for the lower animals: according to *Bischoff* it takes in the Ruminants 4 — 5 days, in dogs 4 — 10 days, and in

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[1]) Lode, Archiv für Gynäkologie, Vol. 45, 1894.

rabbits 3 (according to Hensen 70 hours). With regard to human beings *Bischoff* states, that, counting from the beginning of menstruation, the ovum takes 5 days to reach the uterine end of the tube, so that the assumption seems warranted, that the human ovum traverses the whole length of the fallopian tube in about a week. For an *impregnated* ovum the period can hardly exceed about 8 days, for the uterine end of the tube measures 2—3 mm. in diameter, while the impregnated ovum has already attained a diameter of 3—6 mm. by its second week.

Seminal fluid.

Just as ova are the product of the female sexual organs, so is the Semen that of the male. The Semen in man presents in its pure state a whitish viscid stringy fluid, which, when exposed to the air, dries into a hornlike transparent mass. But the Semen as discharged from the urethra appears less white, is more transparent, and emits a peculiar odour (aura seminalis). Immediately after its discharge it takes on an extremely tough, gelatinous, sticky character. This difference from the pure Semen depends on the fact, that while in Semen, mature and capable of fertilising the fluid portion is present only in extremely small quantity, this does not apply to the Semen as discharged, which is mixed to a certain extent with the secretion from the accessory glands (the Vesiculae Seminales, Cowper's Glands and the Prostate).

The Seminal Fluid is not a homogeneous one but is an emulsion of innumerable organised motile elements, the *Spermatozoa*, in a viscid medium, the seminal fluid proper.

The Spermatozoa are 0,004 mm. in length, and consist of a head or body and a threadlike appendage, the tail or cilium. Every animal species possesses its own peculiar

form of spermatozoon, so that the seminal fluid of a certain genus can fertilise only ova of the same genus.

The most striking peculiarity of the freshly discharged Spermatozoa is their capability of movement, by which they are able in one second to cover a distance equal to 400 times their own length, yet this movement is not a voluntary one. The Spermatozoa exhibit regular rhythmical movements, and various changes in their position, and shape by means of which secondary movement from place to place is brought about. It is chiefly the wave-like wriggling movements of the cilium, which propel the body forwards and in the direction, in which the sharp end of the body or head points. It was these movements too, which caused the erroneous belief, held even by such investigators as *Ehrenberg*, *Valentin*, *Gerber* and *Schwann*, that the organised elements of the seminal fluid were animalcules, endowed with the power of voluntary movement. *Kölliker* was the first, to succeed in refuting positively the notion of the animal nature of the Spermatozoa.

In the freshly ejected seminal fluid of a Mammal the rapidity of movement of a spermatozoon is at its greatest, and according to *Henle* it travels 2·7 mm.. according to *Kraemer* [1]) 2·2, to *Hensen* [2]) 1·2, Charpentier 2·2, and Lott 3·6 mm. per minute. With an average speed of 2·5 mm. per minute the spermatozoon takes about $1^1/_2$ hours to traverse the upper part and vault of the vagina (5 cm. long), the uterine cavity (7 cm. long), and the fallopian tube (about 12 cm. long. But since the path is not a straight line, the rate of motion is subject to alteration, also certain other obstacles are present, then under unfavourable circumstances the spermatozoon requires about 10 hours, to traverse the female genital canal from the

[1]) Kramer: De motu Sper. Diss. inaug, Göttingen 1842.
[2]) Hensen: Physiologie der Zeugung. Leipzig, 1884.

outer orifice of the uterus (os uteri externum) to the ovaries [1]). If it meets an obstacle, it does not stick there, as was formerly generally supposed, but it turns back, as *Müller* [2]) has observed; and *Henle* saw Spermatozoa, which dragged along with them crystals ten times larger than themselves, while *Pouchet* observed them carrying along clumps of 8—10 bloodcorpuscles, which were adhering to their heads.

The rate of movement and the energy of the spermatozoa gradually decreases, until a time comes, when the slow sluggish vibrations of the cilium can no longer overcome the resistance of the body, and the spermatozoon accordingly remains on the spot, until finally the vibrations disappear altogether. In all annimals the so called tail is the active organ of locomotion, and when there is no tail, the power of movement is also wanting. If the cilium is short, it performs only to-and-fro movements or curves to one side, so that the motion of the whole body takes on a hopping character.

Substances favourable to the movements of the spermatozoa are found in the physiological medium for diluting the testicular secretion viz. the secretion of the vesiculae seminales, the Prostate, and Cowper's glands, and certainly also in the secretion of the female generative passages, for spermatozoa introduced by coitus retain for several days in the uterus and fallopian tube their power of movement. *Haussmann* [3]) states, that they retain their vitality in the vagina for $7^1/_2$ days, *Percy* [4]) says 8, and *Bossi* [5]) 10. According to *Hertwig* [6]) human spermatozoa, when intro-

[1]) Centralblatt für Gynaekologie Vol. IX. p. 402.
[2]) Müller, Die Rindviehzucht, Vol. I. Berlin, 1876, p. 649.
[3]) Haussmann: Klinik der Geburtshilfe 1864.
[4]) Percy: Americ. Med. Times, March 1861.
[5]) Bossi: Nouvel archiv. d'Obst. April 1891.
[6]) Hertwig: Lehrbuch der Entwicklungsgeschichte u. s. w. Jena 1886.

duced into the female generative passages, seem to retain their power of movement perhaps for several weeks, and *Dührssen* found in one case $3^1/_2$ weeks after coitus had taken place spermatozoa in the one slightly affected tube alive, but in the other much diseased tube dead. Although this observation agrees with that of *Hertwig*, *Wendeler* [1]) is nevertheless of opinion, that the latter spermatozoa are really derived from the coitus, which occurred $3^1/_2$ weeks before, while the former, those alive in the other tube, must come from a coitus, which may possibly have taken place after the above-mentioned one.

The vitality of the spermatozoa in some animals can be distinctly proved to last for a longer period yet. Thus in the bat it is known, that the spermatozoa remain alive in the uterus through the whole winter, and in the case of the hen we know, that she can lay fertilised eggs as long as 18 days, according to *Harvey* and *Buffon* even 3 weeks, after connection with the cock. The greatest vital power is possessed by the spermatozoa in the receptaculum seminis of the honey-bee, in which they show themselves capable of fertilisation after 3 to 5 years.

Acid vaginal mucus and the very viscid secretion of the cervix uteri suspend the movements of spermatozoa: water, ether, alcohol, chloroform, tannin, acetic acid as well as all mineral acids have a similar action. In the lochial discharge on the other hand spermatozoa retain their vitality, a circumstance, which is illustrated by a case, where conception followed sexual intercourse, which took place 4 days after parturition, foetal movements were felt 4 months after, and a child was born after 243 days [2]). From this observation it follows also, that the activity of the ovary

[1]) Wendeler, in Martin's Krankheiten der Eileiter, Leipzig 1895.

[2]) Jahresbericht über die Fortschritte auf dem Gebiete der Geburtsh. und Gynaekologie 1893.

does not altogether cease during pregnancy, as is generally supposed. The spermatozoa prove to be much more resistent to external influences, than the ova do, which are easily blighted and destroyed: e. g. if seminal fluid is frozen and thawed again, the movements of the spermatozoa reappear.

The organs, which secrete the spermatozoa, the male reproductive organs or Testicles, are glands, composed of fine tubules; they are two in number, similar to each other in size, shape, and position. Each testicle is about 5 cm long, and 3 cm thick, and consists firstly of the Testicle proper, which is shaped somewhat like a flattened egg, and form about $^3/_4$ of the whole mass, and secondly of the Epididymis, an elongated almost cylindrical organ, which lies along the long side of the Testicle proper. From each testicle the spermatic cord runs up to the Inguinal Canal, and through it into the Pelvic Cavity. The spermatic cord consists of the vas deferens, arteries, veins, lymphatics, and nerves and of connective tissue, which binds all these together.

The Testicle consists essentially of a mass of much convoluted, extremely fine tubules ($^1/_6$ mm. in diam.), the seminal tubules, whose length amounts to about 400 metres; in them the spermatozoa are produced. The fully developed semen reaches the outer world through the vas deferens, a tube some 33 cm. long, which rises up from each testicle through the Inguinal Ring into the Pelvis and opens into the upper part of the Urethra. *The walls of the vas deferens consist of relatively thick and strong layers of muscles, which are capable of carrying out powerful peristaltic movements.* Quite close to its opening into the Urethra is situated a sack, the «seminal vesicle» (Vesicula Seminalis), which may be looked upon as a reservoir for the fully formed semen, and at the same time secretes a fluid, which acts as a diluent to it.

Besides the above-mentioned musclefibres, contained in the vas deferens and the Ejaculatory duct (Ductus ejaculatorius), which are active in the emission of the Seminal fluid, other muscles take a part viz: the Constrictor urethrae Ischiobulbocavernosi, Levatores ani, Transversi perinaei, and especially the elevator muscles of the testicles, the Cremasters.

From the time of birth up to puberty in Man the male reproductive glands proceed in about the same stages of development as the female, and the seminal fluid contains only seminal cells but no spermatozoa. Just as the female, so is the male capable of exercising the function of procreation only after a certain age; the reproductive glands as well as the other parts of the generative apparatus attain their full maturity only, when the development of the whole organism has been completed. About the 15-th—16-th year, as in the female, the characteristic sexual appearances begin to show themselves over, the body generally, and in the 17-th or 18-th year, i. e. somewhat later than in the female, sexual maturity is complete.

But while in the female the ripening of ova occurs periodically, the secretion of seminal fluid in the male is characterised by the fact, that it is *a continual process and not periodic,* so that it is possible for him, to bring about an emission of semen at any time, quite independent of the time, of day, or season, of the year; besides, the procreative faculty in the male does not end so soon, as in the female, for under favourable circumstances. it may continue till advanced old age.

After a description of sexual or bi-sexual reproduction. whereby the formation of a new individual is possible only by the union of the male element (spermatozoon) with the female (ovum), a short account of the production of new organisms from unfertilised ova must be given, since in

describing the various hypotheses and theories as to the origin of sex reference will be made to this process.

While in all aminals the fertilisation of ova by spermatozoa is a condition absolutely indispensable for development, we see, that in bees, wasps, ants, and other gregarious finsects, unfertilised ova too pass independently through the whole series of developmental changes up to a fullyformed living organism. This method of formation of new individuals rom unimpregnated ova is denoted by the name *Parthenogenesis.*

The clearest most instructive, and in every way most interesting example of true Parthenogenesis is furnished *by the history of reproduction in the Honeybee.* Every bee hive contains 3 kinds of bees, the queen bee, the drones, and the workers. The queen bee is a perfectly formed female, the drones are males, while the workers are females stunted in development through imperfect nourishment, with ill-developed ovaries, and generative system so defectife, that they are incapable of copulation with the drones. The queen fills the cells made by the workers with eggs in such a way, that the eggs, laid in the wide cells, regularly give rise to males, those laid in the narrow cells to females, and while the eggs which are to form drones are *unimpregnated, each fertilised egg* develops into a female.

The queen is always impregnated outside the hive, and returns home from the nuptial flight with evident proofs of copulation having taken place, viz. the outer orifice of the vagina, which is shut in the virgin queen remains open; the male copulative organ, which has been taken off and has stuck in the vagina has been often found there; and the sack, which serves for the reception and storage of the seminal fluid (receptaculum seminis) is filled with a milky liquid recognisable even to the naked eye, and in this liquid microscopic masses of motile spermatozoa are

visible. This single copulation supplies the queen with active semen for several years, for live spermatozoa have been found in one after 4—5 years. So long as this store of seminal fluid lasts, the queen is capable of laying male eggs in the wide cells. and female in the narrow; an unimpregnated queen, or one, whose store of semen has run out, lays only male eggs.

From this indisputable fact one was inclined to think, that the origin of males from unimpregnated ova was a general law, but we shall see on discussing the theories as to the origin of the sexes, that this idea is false.

Literature: *v. Siebold*, Wahre Parthenogenesis etc. (Leipzig 1856). *Dzierzon*, Rationelle Bienenzucht (Brieg 1861). *Berlepsch*, Die Biene und ihre Zucht (Mannheim 1873). *Claus*, Der Bienenstaat (Berlin 1873). *Siebold*, Ueber die Fortpflanzung der Psyche (Zeitschrift für wiss. Zoologie vol. I, p. 73). *Sir John Lubbock*, on Ants, Bees and Wasps. London 1882.

The sexual instinct.

A real union of ovum and spermatozoon is in the larger majority of animals an essential condition for the formation of new individuals. The fulfilment of this condition must be ensured, and it must be provided for, that these two elements of reproduction are brought into contact with one another in a mature condition at the proper time and place, in short under favourable circumstances generally, and this takes place through the sexual instinct. This instinct may be discribed in general words as the inciting force to all action, which has impregnation for its end and purpose: and diverse as these actions are, corresponding to the variety of the condition for impregnation among the various animals, equally varied are the modifications of the sexual instinct, which is preeminently the attribute of the

male sex. It is this instinct, which impels the male bird to seek out and attract its mate; it is this, that in fishes moves the male to follow the female in heat to the place of spawning and fertilise the spawn there laid. Man too is the slave of the sexual appetite, and very often it is very uncomfortable for those, who are unable to satisfy it.

Yet on the other hand it is fortunate, that Nature has so arranged, that whoever has not experienced sexual indulgence, does not suffer much from the want of it: indeed, animals can be kept their whole life from any satisfaction of their sexual impulse.

Whether the sexual instinct is to be considered exclusively as activity of the central nervous system or simply as the result of a reflex action is not a question, that we discuss here. According to Pflüger [1]) it is set up in men by the distension of the seminal ducts with mature seminal fluid, which presses on and irritates the nerves in the walls of these tubes; while in women it has its origin in the ovary and its functions viz that the great distension of the wall of the follicle irritates the ovarian nerves and produces increased sensitiveness in the Central nervous system. Yet it is not only through the increased function of the reproductive organs, that the sexual appetite in man is aroused, but also through the most diverse forms of excitement, and these often artificial (Hegar) [2]).

According to *Krafft-Ebing* [3]) the sexual appetite is next to hunger one of the most impelling animal necessities, and indeed in many respects is of the some moments as the appetite for food. As far as their origin is concerned the

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[1]) Pflüger: Die teleologische Mechanik der lebendigen Natur. Archiv für Physiologie, Vol. XV.

[2]) Hegar: Des Geschlechtstrieb. Stuttgart 1894. pp. 3, 5.

[3]) Krafft-Ebing, Die conträre Sexualempfindung. Jahrbuch der Psychol. VI, p. 34.

two are analogous; for just as the appetite for food with the concomitant sensation of hunger is stirred up reflexly by certain conditions of the digestive tract with an intensity proportional to these conditions so too the sexual appetite, as has just been pointed out, is indirectly aroused by the reproductive glands, rising and sinking with the degree of their activity. In animals, that are subject to periodic heat, it awakes with the beginning of life in the reproductive glands, and dies down at the close of their activity. In men with their continuous passion, there is never any real break, but only a temporary rise and fall in this appetite; and accidental sexual excitements may at any time increase the activity of the testicles and the sexual appetite probably simultaneously. In the case of women, in spite of the periodic activity of their reproductive organs no corresponding periodic change of the sexual appetite, which at any rate is comparatively less active and less pronounced in its manifestations, has never been proved, nor would such a change either be very compatible with the continuous passion of the male sex. In man therefore the sexual instinct and its gratification is not confined to any particular short space of time; husband and wife can have sexual intercourse with one another at all times. In contradistinction to the lower animals, women during menstruation generally show a diminution of the sexual appetite, and indeed a disinclination and an aversion to sexual intercourse. It even occurs, where impregnation is impossible, or has already taken place. Diseases of the generative organs not infrequently lead to an abnormal increase in the sexual appetite.

The satisfaction of the sexual appetite is combined with a certain degree of voluptuous feeling, which in the male disappears on the discharge of the seminal fluid, and brings to an end the act of coition. In the female however this

feeling, when once it has beginn, lasts longer *(les femmes ont beaucoup moins de volupté que nous, mais que leur plaisir dure plus longtemps)*; yet in this connection it may be remarked, that according to *Guttceit*[1]) out of ten women only two had satisfaction immediately after defloration, and of the rest half of them had pleasure from friction and only after 6 months, or indeed several years experienced the full sensual feeling;[2]) which in the remaining 4 women again never appeared at all. The first of these women *Guttceit* regards as individuals with a fiery passion and love for the male sex, in whom the sensual feeling arises on embrace with any man that they like; the second set are women of little fervor, but with love for men, or indifferent towards them and yet possessed of a strong passion; the third class are women with little passion and with aversion to men.

Lutaud[3]) states, that of 43 women there was in eleven never any sensuous feeling during coition, in 7 it was present only occasionally and even then but very moderate in degree, in 6 others it appeared first after marriage, while in the majority only after several years. All these women were sterile.

I myself am not in a position, to offer extensive statistics on this subject, but I can nevertheless believe, that among those women, with whom I have ever been able, to converse on this delicate matter, I have rarely found one, who had pleasure from sexual intercourse immediately after her marriage; indeed, the majority of them declared, it was only after the first confinement, that they experienced any voluptuous feeling. There was only one lady,

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[1]) Guttceit: Dreissig Jahre Praxis. Wien 1875, p. 321. Vol. 1.

[2]) Krafft-Ebing, Ueber polutionsartige Vorgänge beim Weibe. Wiener med. Presse 1888, p. 465—70.

[3]) Lutaud: Journal de médecine de Paris 1889, № 3.

who in spite of the fact, that she had married from love had not experienced this feeling once in the course of her ten years of married life. Yet I cannot endorse the opinion, that such persons must be sterile, for among others this last-mentioned lady was also pregnant, but had a miscarriage in the fifth month. A subsequent pregnancy, it is true, did not take place, but this was due to the presence of syphilitic disease in the husband. If any of my professional brethren doubt the natura frigidissima of this patient of mine and asks, whether I was even sure, that the lady told me the truth, I can most decidedly reply in the affirmative, and that such a condition of matters could really exist is evident from the statement made by *Hegar*: «*one not at all unfrequently finds even in a strong and healthy woman an indifference, disinclination, and loathing for sexual intercourse even with the man whom she loves*».

Copulation and Impregnation.

By *Copulation*, or (as it is also called in the case of human beings) Coitus, is understood the more or less intimate union of two individuals of the same species, a male and a female, with a view, to the propagation and preservation of that species, whereby an opportunity is given to the product of the male reproductive organs to come into contact with that of the female. The contact of these two products takes place sometimes inside, sometimes outside. the female organism either immediately after copulation or some time after, according to the different organisation of the animals and their generative apparatus. The real purpose of copulation is as a rule impregnation, yet the latter is not a necessary consequence of the former for copulation may have results without impregnation, while impregnation may take place without a preceding copulation.

In man as in mammals generally coitus consists in the introduction of the male generative organ into the female vagina. By this act the irritation of the sensory nerves in both male and female sets up reflex movements, which in the male result in the emission of the seminal fluid, and in the female promote its reception and further transmission. In the male the muscles in the walls of the vasa deferentia and vesiculae seminales are thrown into peristaltic contractions, and force the seminal fluid into the urethra, from which the fluid is ejected intermittently into the vagina as far as the os uteri. In the female also a reflex movement, corresponding to emission, is set up at the height of the sexual excitement: this is a peristaltic movement of the fallopian tubes and the uterus, running from the end of the tubes to the portio vaginalis (vaginal pertion of uterus), and by it a certain amount of the mucus normally lining the uterine walls is forced into the vagina. The uterus is erected by the powerful contraction of its muscular fibres and round ligaments, so that its orifice (os), which was before directed more backwards, now points more downwards, while the uterus descends further towards the vagina. When the uterus returns into the relaxed condition again after the stage of excitement, it aspirates into its cavity the seminal fluid, injected against the os. (*Aristotle*, *Bishoff*, *Litzmann*, *Eichstadt*, *Landois* p. 1001).

Suction of this kind, however, is not absolutely necessary for impregnation, for the spermatozoa are able by their own movements to wriggle into the uterus, as is proved by observation of cases of pregnancy, where the penis has not passed into the vagina during coition, and in these cases therefore the spermatozoa traverse the whole length of the vagina to get into the uterus.

Fertilisation must not necessarily always follow every act of coitus, for to produce pregnancy it is necessary (a)

that the ova arise and mature normally, (b.) that the spermatozoa are normally developed and preserved, and that their contact with the ovum is rendered possible; and lastly (c.) that the uterus is fit to allow of the incubation of the fertilised ovum in it. It is of course self-evident, that in the absence of the ovaries, or with such organic change in these organs that they cannot exercise their function, impregnation will be impossible. Through disease of the fallopian tubes the ovum may be unable to reach the uterus, and in the same way an obstacle to its passage is effected by those tumours, which, growing from the fundus so fill up the whole uterine cavity, that the ends of the tubes appear completely closed. The passage inwards of the spermatozoa, again, may be hindered by an abnormality in the vagina either from change of position or of structure from pathological causes. In all these cases the women are sterile; but on the other hand we cannot infer, that women, who have no children, must necessarily be affected with disease, i. e. the cause of sterility lies in them.

Up to the middle of this century it was held, in accordance with the experiments of *Spallanzani*, [1]) that impregnation consisted in the direct contact of the motile spermatozoa with the mature ovum of the female, but *Barry* [2]) made the discovery, that the spermatozoa not only come into contact with the ovum, but actually penetrate into it by boring through the vitelline membrane. But, although *Nelson* [3]), *Newport* [4]), *and Keber* [5]) also confirmed this fact.

[1]) Spallanzani, sur la génération. Deutsch. Leipzig 1786.

[2]) Barry: Embryol. Research. in Philosoph. Transact. a. 1840. Part II. p. 532. b. 1843. Part. I. p. 33.

[3]) Nelson: on the reprod. of Ascaris. Philos. Trans. 1852. Part II p. 563.

[4]) Newport: on the impregnation of the ovum. Philos. Trans. 1851. Part I. p. 240; 1853 Part II p. 233 and 271.

[5]) Keber: Ueber den Eintritt der Samenzellen in das Ei. Königsb. 1853 and appendix 1854.

it took some time before the deep-rooted disbelief of the passage of the spermatozoa into the ovum itself was given up by the greatest opponents (*Bischoff*, *Funke*), and the entrance of the spermatozoa into the interior of the ovum, which was so long controverted, may indeed now be looked on as the most essential point in the process of impregnation.

The finding in insects' eggs of a preformed opening (the micropyle) for the passage of the spermatozoa was of the greatest significance for this discovery *Leukart* [1]) *Meissner* [2]), v. *Siebold* [3]). In many animals the ova, before fertilisation takes place, are enveloped by a thick firm covering, which the spermatozoa cannot possibly penetrate: thus, in order to render fertilisation possible, there is situated at a definite spot in this covering one or more small openings (the micropyle), at which the spermatozoa collect, and wriggle into the interior of the ovum. In the Petromyzon the passage of *one* spermatozoon into the ovum through an already existing micropyle in the vitelline membrane has been minutely followed *(Hertwig)* [4]). In the human ovum a micropyle has as yet not been discovered, although *Keber* affirms that he has found one.

After the seminal fluid has been injected during coitus into the vagina usually as far as the os uteri, it is taken up from here or indeed aspirated (Valisneri) [5]) and takes several hours, or even days according to circumstances, to reach the place, where the ovum to be fertilised is

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[1]) Leukart: Ueber die Mikropyle, Müllers Archiv 1855. p. 90.

[2]) Meissner: Ueber die Befruchtung des Eies etc. Verhandlung d. naturwissenschaft. Gesellschaft zu Basel 1851. Vol. III. p. 374.

[3]) v. Siebold: Wahre Parthenogenesis. Leipzig 1856.

[4]) Hertwig: o. c. p. 32 and 33.

[5]) Valisneri: Ueber die Erzeugung d. Menschen, in Haller Elem-Physiol. Vol. VIII p. 2. and Wagners Handbuch d. Physiolog. Vol. III[1]. p. 53.

lying Partly through their own movement, partly passively the spermatozoa reach the interior of the ovum, sometimes through pre-existing channels in the vetelline membrane, sometimes through openings they have bored themselves; and in this connection it is a mystery hitherto unexplained, what power that is, by which spermatozoa, which in their own menstruum are checked by slight opposition, even change their direction during their advance and their passage into the ovum, if they meet with considerable resistance in dense layers of albumen and finally in the vetelline membrane. If these regular purposive movements of the spermatozoa had been known a hundred years ago, if it had been observed, how they in large numbers steering all towards one goal, bore into the albuminous layer of the ovum of the frog with great rapidity, this would have been certainly regarded as a new and important proof of their animal nature, and of their movements being guided by volition according to their objects.

According to *Janke* [1]) this process may be best compared with the coitus of the two sexes: «The spermatozoon in its character as male element seeks out the female element, the ovum; thus, in so directing its course towards the latter, the former is as it were impelled by the very same sexual instinct, which draws male towards female for coitus».

As regards the number of spermatozoa necessary to produce the impregnation of one ovum, it was taken as a rule, that only a small number, or perhaps only a single one, was required: *according to Hertwig and Landois* **only one spermatozoon** *effects the impregnation. Sobotta* [2]) too found, that in mice never more than one spermatozoon

[1]) Janke: o. c. p. 46.

[2]) Sobotta: Die Befruchtung des Eies der Maus. Anatom. Anzeiger 1891.

passes into the ovum. At the spot, where the spermatozoon touches the surface of the ovum with the point of its head, the clear layer of protoplasm, which is spread over the surface, immediately rises up into a small protuberance, the «point of conception», which is often drawn out into a fine point: and here the spermatozoon bores into the ovum by means of the to-and-fro movements of its tail. Within the short period of 1—2 seconds the head has penetrated half the thickness of this layer (Star-fish, Sea-urchin [1]). At the same time a delicate membrane over the whole surface of the vitellus, becomes detached from it beginning at the point of conception and separated by a space, which grows larger and larger. In the process of fertilisation this membrane seems to have the purpose that, when it is separated from the vitellus — and this takes place very quickly — all other spermatozoa coming after the first (in the rabbit as many as 60 spermatozoa have been seen boring through this membrane) find the way closed. At all events of all the other spermatozoa, that are moving to and fro in the cavity not one now gets into the fertilised ovum.

It is out of the question in a short general description of Reproduction such as this to give a succinct account of the various views as to the place, where the actual impregnation of the ovum takes place, and all the more so, since according to *Martin* [2]) the place of physiological contact between spermatozoon and ovum is not fixed. For our purpose it suffices to know, that impregnation may occur in the fallopian tube (Prevost and Dumas [3]) as

[1]) Kollmann: Lehrbuch der Entwicklungsgeschichte des Menschen. Jena, 1898.

[2]) Martin: Ueber ectopische Schwangerschaft. Zentrallblatt für Gynaekologie 1892 no. 39.

[3]) Prevost and Dumas: Annales des Sciences nat. 1824. Vol. II. p. 104.

well as on the ovary itself. Usually the spermatozoon gets up to, and impregnates the ovum during its passage through the tube. Since it is known, that these two elements traverse the fallopian tube in opposite derections one would be inclined, to think, that their meeting and union too must take place here. While impregnation in the uterus itself was formerly regarded as extremely doubtful, it has been recently located chiefly in this organ. Up till the year 1893 *Martin* adhered to the opinion, which was vigorously advocated by *L. Tait* and ably supported by *Wyder*, that the union of ovum and spermatozoon normally takes place in the uterine cavity, but through the observations of *Sobotta* he has been more recently led to throw doubt on this view, since observations on mice and rabbits established the longknown fact, that in these animals the fertilised ovum traverses the whole length of the fallopian tube, till it settles in the cavity or horn of the uterus. According to *Wendeler* [1]) impregnation in man most probably takes place in the outer third, the abdominal portion, of the tube, and this has been proved by numerous observations on various mammals. But impregnation may also occur *at* the ovary (Abdominal pregnancy) or *in* the ovary itself (Ovarian pregnancy) [2]).

[1]) Wendeler: Krankheiten der Eileiter, von Martin. 1898. p. 309.

[2]) Note: *Bischoff* (Theorie der Befruchtung Müllers Archiv. 1847. p. 422 und Oestreich. Vierteljahrschrift für wissenschaftliche Thierkunde Wien 1865, p. 107) has been misunderstood by these, who regarded him as holding, that impregnation in mammals takes place exclusively *at the ovary:* he only showed the *possibility* of impregnation there, but by no means maintained, that it took place there and there alone. *Bischoff* says in his Embryology of the ovum of the dog: — It is therefore certain, that the ova *can* be fertilised in the fallopian tube; yet I am far from asserting, that *impregnation always* takes place *in the ovary*: on the contrary I rather believe now, that this may only seldom happen, since the ova will generally burst from their follicles too soon, to give the spermatozoa time to reach the ovary. Sperma-

As regards the period, at which impregnation of the ovum by seminal fluid takes place, *Pouchet*, *Raciborsky* and *Bischoff* state, that the time immediately following menstruation is not only the most suited, but is generally the only one, in which it occurs. *Hyppocrates* [1]), indeed, considers a woman most susceptible immediately after menstruation, and in a less degree so during it. The same opinion is also found in *Galenus* [2]) *Schurig* [3]), *Storch* [4]), and *Moriceau* [5]). But there is not the slightest doubt, that impregnation takes place even several days after menstruation, for the ovum retains its inherent capability of being fertilised for a certain length of time after its discharge from the ovary, although the ovum, as has already been remarked, possesses in comparison to the spermatozoa a shorter length of life, and a smaller power of resistance. How long, however, a discharged human ovum remains capable of impregnation in the fallopian tubes or in the uterus, we do not know, for it has never yet been possible, to find an unimpregnated ovum in these places. It seems, as if this period may be fixed at 8 up to, at the most, 14 days; at any rate the spermatozoon retains its capacity to fertilise for a long time in the tubes and this

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tozoa and ova will, accordingly, usually really meet each other in the tube, and here too impregnation will take place. In the uterus itself the ova are scarcely any more capable of impregnation".

[1]) Hippocrates: De natura generi C. III. Quare si illo sanguine vacuata mulier fuerit, concipit; si vero is redundavit, minime.

[2]) Galenus: De semine. Lib. I. Id vero (conceptus) potissimum fit quam menstrua novissime cessarunt, quo maximo tempore uteri semen concipiunt.

[3]) Schurig:—feminas plerumque circa tempus menstruationis vel potius cessante mensium fluxu facilius alio tempore foecundum coitum poti atque concipere.

[4]) Storch: Von den Krankheiten des Weibes. 1748. Vol. III.

[5]) Moriceau Aphorismes, touchant la grossesse. Paris 1694.

too has been proved by *Bischof* and *Hertwig* [1]) in mammals if not in man, by the fact, that they found living spermatozoa on the ova long after copulation had occurred. In an impregnation, therefore, within the first 8—14 days after menstruation it can be assumed, that the spermatozoon has passed into a discharged ovum of the *preceding* period: if on the other hand a coitus with subsequent impregnation has taken place *later* than midway and between 2 periods, then we can with greater certainty take it for granted, that the seminal fluid has advanced perhaps as far as the ovary, and awaited the ovum discharged at the next menstruation.

The ovum, discharged from the ruptured follicle and fertilised, is taken up by the fimbriae of the fallopian tube, which seldom fail in their function, for the ovum reaches the mouth of the tube (ostium abdominale) with great certainty, and makes its way to the uterus, in the Ruminants in 1—5 days, and in Dogs, in 8—10 (Bischoff) [2]). The fertilised ovum does not always stick to the first best place in the uterus, it finds, but moves from one place to another and it often happens, that an ovum shifts from the right horn into the left, or vice versâ.

In twins (Horse, Ox) ova are found in both horns, although they come from one and the same ovary. This fact has been established in man in a large number of similar cases after the ovum has found the most suitable place and fixed itself, it there goes through all the changes necessary for the formation of a new individual. It may be here remarked, that impregnation takes place only, when the male and female reproductive elements are derived from

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[1]) Hertwig: o. c. p. 18.

[2]) According to Hyrtl (Henle and Pfeufers Zeitschr. f. rationelle Medizin, new series IV, p. 155): never under any circumstances longer than 4 days.

animals of the same species, and only exceptionally, when they come from animals of different species, but yet belonging to one and the same genus, as is the case in the production of so-called hybrids. Impregnation does not take place, when the reproductive-elements of two animals belonging to different genera are brought together.

Extrauterine Pregnancy.

It happens not very infrequently, that the uterus does not form the seat of development of the ovum, but instead of it the fallopian tubes, or perhaps even the ovaries, or some spot in the peritoneal cavity, according as the ovum is arrested in the tubes on its way to the uterus by some obstacle or other, or on the rupture of the follicle is not as usually, at the same time discharged (while it becomes impregnated by the spermatozoa, which have advanced as far as the ovary), or finally loses its way and wanders into the peritoneal cavity. In very exceptional cases the ovum discharged from a ruptured follicle of one ovary may enter the tube of the other side, as is proved by the occurrence of pregnancy in an abnormal rudimentary horn of the uterus, where the corpus luteum has been found in the ovary of the opposite side: *external migration (Kussmaul, Leopold).* Whether *internal migration* also occurs is much doubted by many. A large number of such cases of external migration has already been proved in Man, as well as in the domestic animals. Thus, *Kehrer* three times observed the corpus luteum in one ovary, and the foetus in the opposite horn; the foetus of a mare in the right horn with the corpus luteum on the left side *(Frank);* and lastly, corpora lutea were seen in the right ovary of a cat, but not one in the left, while there were two embryoes present in each horn *(Kehrer).*

The development of the fertilised ovum in an abnormal situation is called *ectopic* or extrauterine pregnancy.

Martin [1]) finds, that the danger of an extrauterine pregnancy arises only in such cases, where spermatozoa have abnormally passed beyond the ostium abdominale of the fallopian tube.

Multiple Pregnancy.

A woman usually gives birth to only one child at a time, and rarely to several. and it cannot be denied, that here racial distinctions exercise a certain not inconsiderable influence, and a hereditary tendency is an important factor.

a) Twins.

While in *Germany* according to *Meckel v. Hemsbach* and *Veit* there is only one twin-birth to about 88 single, it is found that in *France* the proportion of twin to single births is 10 per 1000, and in *Italy* according to the region 7, 15, and 42 per 1000; in *Russia* twins are born on an average once for every 50 single births.

Special attention must here be drawn to the fact, that in twin births the ratio of boys to girls remains almost exactly the same as in single births, viz. 105·8 boys to 100 girls. Out of 13 million births there were 150,000 twin, and of these there were in round numbers 50,000 times two boys, 46,000 times two girls, and 54,000 times a boy and a girl [2]).

The origin of twins may be explained in the following ways: a) two Graafian follicles burst from one and the

[1]) Ueber die Aetiologie der ektopischen Schwangerschaften. Zeitschrift. für Geburtshilfe u. Gynaekologie. Vol. XXII, p. 205.

[2]) B. S. Schulze: Ueber Zwillingsschwangerschaft. Volkmanns klinische Vorträge, 34.

same ovary, and the ova discharged from these are impregnated at the same time; b) two Graafian follicles burst one from each ovary; c) one follicle may contain 2 ova; d) a single ovum may possess 2 nuclei; and lastly e) out of one follicle a single ovum with only one nucleus is discharged, and this nucleus divides into two.

Whether now the twin pregnancy comes from one follicle, or from two follicles in the same ovary, or from both ovaries, is determined solely by the corpus luteum. In the majority of cases 2 true corpora lutea are found either both in the same ovary, or one in each. According to *Hellin* [1]) multiple pregnancies arise as a rule from the simultaneous rupture of several follicles, and this again in his opinion is the result of the presence of a large number of ova in the ovary. The presence of two ova in one follicle is to be regarded, he thinks, as the regular cause of twin pregnancy; while on the other hand *Pflüger*, *Slaviansky*, *Schrön* and *Hensen* have seen several ova in one follicle.

In the cases a) and b) the twins will lie in separate foetal-sacks (chorion) and while in a) the twins must be of the same sex they must be of different sex in b); in d) and e) the twins will lie in a common chorion and will be without exception of the same sex; in c) it may be supposed, that the foetus lie in separate sacks. In the first two cases one will always find 2 corpora lutea, and in the other three cases only one. While in a) and b) the origin of twins is self evident, some small explanation must be given for the other cases; c) and d). There is an observation, made long ago especially in birds, that one egg contains two yolks, and observations of this condition in Man also are not wanting: an accidental condition, which although not new is rare,

[1]) Hellin: Die Ursachen der Multiparität der uniparen Thiere. München, 1895, d. 3 and 58.

may be here cited viz. that of a follicle of the outer layers of the right ovary, which contained an ovum with two nuclei. The follicle, which was distinguished from the other follicles of the same maturity by its size, was enveloped in a single cell layer. The ovum itself was also somewhat larger than the others; both nuclei, each some-what smaller than single nuclei, were lying close to one another and were flattened on their contiguous surfaces. In other respects they were perfectly similar to ordinary single nuclei *(Paltauf)* [1]). With regard to twins, whose formation is due to the division of a single germinal vesicle (e), it must be remarked, that this is one of the more recent explanations, but the part, which the spermatozoon also plays in this division has, in my opinion, not been sufficiently taken notice of. Thus, *Krause* [2]) has also observed a human spermatozoon with two heads. Finally it must be remembered, that while in the ordinary course of impregnation only *a single* spermatozoon penetrates into the ovum, so long as both these reproductive elements are healthy, yet in an injured condition of the ova a multiple impregnation by two or more spermatozoa may take place, so that the origin of the formation of two or more embryoes is to be referred to the passage of 2 or more spermatozoa into the ovum, and *Mirabeau* [3]) considers it possible, that multiple pregnancy may in certain circumstances also arise from the male element of reproduction, the spermatozoon itself.

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[1]) Paltauf: Die Schwangerschaft in Tubo-ovarialcysten. Archiv f. Gynaekologie. Vol. 30, p. 463. From the older Literature: Bidder, Müllers Archiv 1842, p. 36. Bischoff, ibid. 1843, p. 165.

[2]) Krause: Internat. Monatschrift für Anatomie und Histologie. Vol. III. 1886, p. 336.

[3]) Mirabeau: Frommels Jahresbericht. Wiesbaden 1895.

b) Triplets.

Triplets are in comparison to twins much more rare, and it is reckoned, that in general there is one triple-birth out of 5000 *(Scanzoni)* — 6000 single birthes. There too we see the influence of racial distinctions: in *Russia* triplets are born once for every 3600 births, in *France* 6209, and in *Germany* 7910.

Triplets may arise in the following ways: 1) Three follicles rupture in one ovary, and their ova are impregnated; 2) in one ovary two follicles rupture, and of these the one contains 2 ova or 2 germinal vesicles; 3) in each ovum there is only one germinal vesicle, of which one of them divides; 4) one Graafian follicle bursts, which contains 3 separate ova; 5) from the one ovary one follicle bursts, and from the other ovary two; 6) from each ovary only one follicle ruptures, and one of these contains 2 ova, or 2 nuclei in one ovum; and lastly; 7) from each ovary only one follicle with a single ovum bursts, of which one divides.

As regard the chorion and the sex of the children, that will be quite evident, when one bears in mind, what has been said of twins.

It may be here just remarked, that I consider the rupture of 3 Graafian follicles from one and the same ovary in man as extremely rare, indeed extremely improbable, while on the other hand the formation of triplets from the other causes just mentioned is self-evident. Doubt might only arise, whether three ova really occur in one follicle; one proof, that this is true is furnished by *Klien* [1]), who found in a girl, who had died, 8 follicles with two ova, and 1 follicle with three.

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1) Klien: Münchener Medic. Wochenschritt 1893, no 27, p. 526.

Hellin [1]), whose work I would specially recommend to those, who are interested in Multiple Pregnancy, pronounces Multiple Pregnancy to be, as it were, an atavistic phenomenon.

c) Quadruplets.

A quadruple pregnancy is a thing of the greatest rarity. In France it occurs once in 121,000 single births, and in the Dublin Lying in Hospital according to *Meissner* once 152,395, while in Germany according to *Veit* it appears once in 371,126, and according to *Neefe* [2]) only once in 560,000. One must consider Crimmitzschau and Glauchau specially productive in this respect, for within 23 years quadruplets were born three times out of 20,000 births viz: in 1847 four girls, in 1869 two boys and two girls, and in 1870 four girls *(Leopold)* [3]).

Of pregnances with more than 4 children at one time I may quote the fallowing cases from Hellin:

1. *Küster* [4]): One woman gave birth to 44 children, 30 by her first husband within 22 years, and 14 by her second within 3 years (a 3—, 5—, and 6— birth). This woman however is surpassed in fecundity by another, who in 33 years of married life is said to have had 48 children, and of these 8 were quadruple birth. The non plus ultra of fecundity is shown by the woman, who according to *Burdach* [5]) in 27 confinements gave birth to 59 children, which included besides single births 6 times twins, 7 times triplets, and 4 times quadruplets.

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[1]) Hellin: o. c. p. 54.

[2]) Neefe: Jahrbücher für Nationalökonomie. Vol. XXVII.

[3]) Leopold: Archiv für Gynaekologie. Vol. II, p. 285.

[4]) Küster: Ueber Zwillingschwangerschaft. Dissert. inaug. Würzburg, 1869.

[5]) Burdach: vide B. S. Schulze: Zwillingschwangerschaft.

2. *Desault* [1]). One woman had twice twins, and 3 times births of five.

3. *Galopin* [2]). One woman, who had previously had 5 single births and once twins, gave birth to 5 at one time.

4. *Pereira da Cruz* [3]). First 2—, then 3—, and lastly a 5— birth.

5. *Meneault* [4]). One woman had in each of her first two confinements given birth to one child; in her third confinement she had twins, in the next five, and in the fifth again twins.

6. *Mirabeau* [5]). In one woman first two at one birth, then five, then again twins, and lastly triplets.

7. *Vassali* [6]). Once 6 children at one birth.

8. *Bernheim* [7]). From quite recent times a fully reported case of 5 at one birth as observed by Mathews is to be recorded,

In all the literature, accessible to me, I have as yet found no record of a birth of more thau 6, and *Volkmann* [8]) alone records that in Hameln. a. W. in a house in Emmern Strasse there is a picture of Christ on the cross with two persons, kneeling at the foot of it and 7 children represented as dolls, and underneath is the inscription, written in verse, that to Thiele Römer and his wife were born on 9-th January 1600 two boys and five girls at one time.

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[1]) Desault: Gaz. des hopiteaux 1856, p. 380.

[2]) Galopin: Journ. de Bruxelles 1869. Vol. 45.

[3]) Pereira da Cruz: Frommels Jahresbericht 1889, № 3, p. 59.

[4]) Meneault: Gazette hebdom. 1882, no 40.

[5]) Mirabeau: Ueber die Drillingsgeburten: München. med. Abhandlungen 1894.

[6]) Vassali: Cazo di Gravidanza sesquigemellara. Gaz. ital. lombardo. Milan. 1888, p. 218.

[7]) Bernheim: Deutsch. med. Wochenschrift 1896, no 17.

[8]) Volkmann: Deutsch. med. Wochenschrift 1899, no 19.

There are therefore altogether 9 cases of five at a birth, and 2 of six on record.

Superfoetation and Superfecundation.

It remains yet to mention in a few words two conditions, which are denoted by the names *superfoetation* and *superfecundation*. *Superfoetation* in man is according to the present view of the process of reproduction and development inadmissible, it is, as *Wagner* expresses it, a physiological impossibility. By superfoetation we understand that condition, where some considerable time after the ovum has entered the uterine cavity and therefore the decidual membrane is already formed. a second ovum is said to be impregnated.

Although one finds cases of superfoetation of this sort in man recorded in literature, e. g. among others in more recent times by *Wight* [1]) in Trinidad, they do not bear a critical excamination of all the circumstances [2]). As regards superfoetation we may briefly draw up the following deductions. 1) The vast majority of all known cases of alleged repeated impregnation rest upon intentional fraud of illusion. 2) A large proportion of such cases is nothing more than twin pregnancies. 3) The repeated impregnation of one, who has already been impregnated and at the most several days previously cannot be denied. 4) The impregnation of a woman, who is already several weeks or indeed months pregnant, is not as yet proved beyond doubt. On the other hand this condition has been proved in mares and cows beyond any doubt, yet in order that superfoetation may occur, menstruation must again appear during

[1]) Wight A. W., British med. Journ. 1895 July, 6-th.

[2]) Several cases cases of this kind critically examined are to be found in F. L. *Carper*: Practisches Handbuch der gerichtlichen Medic. Berlin 1860. Vol. I, p. 232—241.

pregnancy and the pregnant animal of course again covered. The following case may serve as an example of superfoetation: A mare, covered on the 19-th March 1863, was again at the next period covered for the second time on 23-rd May of the same year. On 18-th March 1864 a weakly foal was born. On the 9-th day after its birth the mare was brought to the stallion but would not let him cover her. On 31-st March 1864 she menstruated, and was covered. On 27-th May 1864 she gave birth to a dead full time foal (*Frank* [1]).

Those who are interested in superfoetation I would further refer to. 1) Wochenschrift für Thierheilkunde und Viehzucht 1865, p. 143, 1866, p. 46 und 1872, p. 11. 2) Magasin für Thierheilkunde von Gurlt und Hertwig 1847. 3) Mitteilungen aus der thierärztlichen Praxis im preussischen Staate von 1866—1867. Berlin 1868.

By *superfecundation* is understood that condition, in which, a short time after the impregnation of the first ovum (from a few hours till at most 3 days) but yet before the decidua has been formed, the impregnation of a second ovum takes place. There are indeed physiologist as well as gynaecologists, who deny its existence, but it has been proved by several examples in man and by numerous cases in the lower animals, of which ane may be convinced at the end of this treatise (4-th objection). In man it is not possible to produce proof of the impregnation of 2 ova by 2 acts of coitus, separated by time from each other—superfecundation—either with the same father or with different fathers of the same race. In the lower animals e. g. in dogs and cats the proof of different sires for the same litter is often easy.

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1) Frank: Handbuch der tierärztlichen Geburtshilfe. Berlin 1876, p. 120.

It is scarcely going too far, to assert, that with man as soon as he had reached a certain degree of civilisation, the question after his own self and his origin was among the first that concerned him, for we not only see it raised among the Romans, Greeks, and Jews, but actually find in the old Indian physicians and according to Ploss [1]) even in the Ayurvedas a description given of the procedure, that must be taken in order, to produce a male child. And as a matter of fact the question of the origin of sex runs like a red thread down through the ages till the present time, indeed there is scarcely any other question, which has been the play thing of hypothesis from the earliest times downwards to the same degree, as that concerning the causes of the difference of sex. Now it was some sober theory founded on fact or supposed fact, now some notion born of the imagination, or an idea suiting the popular belief, all striving in turn for the predominance.

Although many scholars consider the production of the sexes according to choice as a problem of the greatest difficulty and a riddle, which the human mind cannot solve, nevertheless there have never been wanting men, who strove with the greatest expenditure of energy and intellect, at least to lift, if not completely to tear asun-

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[1]) Ploss: Das Weib in der Natur- und Völkerkunde. Leipzig 1885. Vol. I, p. 360: „The wife shall for 3 days after her menstruation under special diet keep apart from her husband, but on the 4-th day shall washed and dressed in new clothes show herself to him again".

der, the veil of the mystery, which shrouded this question of Sex.

It is not the object of a short treatise, such as this, to discuss minutely all the hypotheses and theories either according to their historical interest or their intrinsic value for they already number hundreds, yet a general survey of certain theories should not be omitted, and for this purpose I consider it practically correct, to divide all these theories into two groups, according as they are founded on *statistical accounts*, collected partly from the breeding of horses, cows, and sheep, partly from experience with human beings themselves, or as they rest upon an *anatomical-physiological* basis.

I. Statistical Theories of the Origin of Sex.

The first division, which might be called the Statistical, is the true meeting-place of all imaginable hypotheses, notions and theories, and there is scarcely a circumstance, which could be on the slightest degree brought into relation with copulation, impregnation etc., that should not at once furnish the true cause of the origin of the two sexes. In this great confusion, however, one can easily find one's way by breaking up this division into subdivisions, theories of (a) *Transsmision of the sex from the parent of the same sex* (b.) *Transmission from the parent of the opposite sex.*

a. Transmission of the same Sex.

According to a wide spread opinion, the sexual union of two individuals, or copulation is nothing more, than a contest between the man and wife not only for the transmission of their peculiarities of character, but also for the determination of the sex of the future offspring, whereby the prevailing party decides the result in this way, that

the *male parent* of course brings about of a *male child*, while the *female parent* is to be regarded as prevailing as often as a *female child* is born.

Amongst others who support this theory, we may mention the following: *Anaxagoras* [1]), *Hippocrates* [2]), *Aristotle* [3]), *Parmenides* [1]), *Avicenna* [4]), *Couteau* [5]), *Henke* [6]), *Venette* [7]), *Schneegass* [8]), *Steinbach* [9]), *Hofacker* [10]) *Sadler* [11]), *Belingeri* [12]), *Mayerhofer* [13]), *Thury* [14]), *Morello* [15]), *Robin* [16]), *Leuchs* [17]), *Pflüger* [18]), *Dusing* [19]), *Schumann* [20]), *Heinke* [21]), *Roth* [22]), *Wilkens* [23]), and *Wall* [24]).

[1]) Baas, T. H., Grundriss der Geschichte der Medic. Stuttgart 1876.

[2]) Hippocrates, Epidem. Bd. II. Sect. 4.

[3]) Aristotle. Politik und Fragment etc.

[4]) Avicenna, Canon med. Bd. I.

[5]) Couteau, L'art de faire des garcons. Montpellier 1760.

[6]) Henke: Völlig entdecktes Geheimniss der Natur. etc. Braunschweig. 1786.

[7]) Venette: Tableau de l'amour conjugale. London 1799.

[8]) Schneegass Ueber die Zeugung. Leipzig 1802.

[9]) Steinbach: Quae parentum vis. Dissert. Monaco 1823.

[10]) Hofacker: Ueber die Eigenschaften, welche sich beim Menschen und Thieren auf die Nachkommenschaft vererben. Tübingen. 1828.

[11]) Sadler: The law of population. London 1830.

[12]) Belingeri: Dell influenza del cibo etc. Torino 1840.

[13]) Mayerhoter: Ueber die Entstehung des Geschlechts. Wiener med. Press. 1853.

[14]) Thury: Ueber das Gesetz der Zeugung der Geschlechter. Leipzig 1864.

[15]) Morello: L'arte di creare i Sesse a volontà. Catania 1876.

[16]) Robin: Memoire sur l'art de faire produire le Sex. Paris. 1876.

[17]) Leuchs: Knaben oder Mädchen. Nürnberg 1876.

[18]) Pflüger: Zur Frage der das Geschlecht bestim. Ursachen Archiv. für Physiol. Vol. 26. Heft 5 u. 6. Bonn 1881.

[19]) Düsing: Die Factoren, welche die Sexualitat entscheiden Jena, 1883.

[20]) Schumann; Die Sexualproportion der Gebornen. Oldenburg 1883.

[21]) Heinke: Die Entstehung des Geschlechtes beim Menschen, Thiren u. Pflanzen. 1884.

[22]) Roth: Die Thatsachen der Vererbung. Berlin 1885.

[23]) Wilkens: Thiel'sche landwirthschaftliche Jahrbücher. Vol XV. Part 4. 1886.

[24]) Wall: Some considerations in regard of the causation of sex. Lancet 1887. Feb. 7.

Hippocrates [1]) may be considered the founder of this theory of Transmission of sex from the same sex, for he says: «And there exists in men as well as in women both male and female semen. The male is however stronger than the female and therefore he must necessarily be produced from stronger semen. The matter therefore stands so: if a stronger semen is discharged by both man and wife, then a male child is born, and if weaker semen—then a female.

According to *Rhazes*, Muhamed ebn Zacharia etc. (850—939), too, children are formed by the coalescence of male and female reproductive elements in such a way that, if the former is the stronger *a male child* is born, while if the latter has the greater strength *a female child* is produced.

Of the principal supporters of this theory in recent times are *Wall* [2]) who has gathered his conclusions from the results of statistics and taken from the royal houses of Europe, the Peerage, and the families of the English nobility and *Düsing* [3]), who has also proved the relation of the sexes in man, the lower animals and plants on statistical bases, and comes to the conclusion that *a young ovum inclines to the female sex* and a correspondingly *young spermatozoon to the male sex:* according to *Mayerhofer* [4]) the sex is decided during conception by the reciprocal action of ovum and spermatozoon. *The human ovum endeavours* under all circumstances, to produce *the female sex* during impregnation, while *the spermatozoon seeks to pro-*

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[1]) Hyppocrates: De Genitura chap. II. Et in viro tum mulebre tum masculum semen inest, eodemque modo in muliebre se habet. Masculum vere Semineo robustius est. Generationem igitur a robustiore fieri necesse est. Hoc quoque modo se res habet. Si quod ab utroque semen prodit: robustius fuerit, mas. generatur, si debile-femina.

[2]) Wall: o. c. p. 261.

[3]) Düsing: o. c., p. 461.

[4]) Mayerhofer: Archiv für Gynäkologie, Vol. IX. 1879, p. 443.

duce the male. A male or female child will result according as the spermatozoon or the ovum proves the strongest in this contest.

b. Transmission from the opposite sex.

According to the theory of the production of sex from the parent of the opposite sex, the prevailing party produces *offspring not of the same, but of the opposite sex*, so that the *production of a boy* depends not on the predominancy of the father, but *on that of the mother,* while *in the production of a girl the father as being the stronger is supposed to prevail. Richarz* holds, that sex is not one of the transmissible attributes of the parents, but is entirely dependent on the condition of the generative power of the mother; if it is weak, then a girl will result, while if the maternal organism as regards the power of propagation is very active, then a boy is born, for the male sex is nothing more than a higher degree of development of the germinal element. As supporters of this theory we may mention among others: *Girou* [1]), *Guttceit* [2]). *Stieda* [3]), *Bock* [4]), *Richarz* [5]), *Koch* [6]), *Berner* [7]), *Clark* [8]), *Felkin* [9]), *Wilson* [10]), preeminently *Janke* [11]).

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[1]) Girou: Ch., De la génération. Paris. 1838.

[2]) Guttceit: Dreissig Jahre Praxis. Wien. 1875.

[3]) Stieda: Das Sexualverhältnis der Gebornen. Strassburg. 1875.

[4]) Bock: Das Buch vom ges. u. krank. Menschen. 1889, p. 656.

[5]) Richarz: Ueber Zeugung und Vererbung. Bonn. 1881.

[6]) Koch: Ueber die Richarz'sche Lehre: Allg. Zeitschrift. für Psychiatr. Vol. 38. 1882, p. 35.

[7]) Berner: Ueber die Ursachen der Geschlechtsbildung. Christiania. 1883.

[8]) Clark: The thesis of Sex Detroit Lancet. 1883—84.

[9]) Felkin: A contribution of the determination of Sex. Edinb. Med. Journ. 1886, p. 233.

[10]) Wilson: Uganda and the Egyptian Soudan. Edinb. 1892.

[11]) Janke: Die willkürliche Hervorbringung des Geschlechtes. Stuttgart.

I cannot comprehend, how any one can so persistently stick to the idea of looking upon the act of copulation as a contest for the sex, for such a contest in the case of man, not to speak of the lower animals even, is entirely out of the question.

If it were really the case, that the prevailing party in the contest transmits to the offspring either the same sex (according to theory a.) or the opposite (according to theory b.), then *the first-born* (among human beings) *must almost without exception be either a boy* according to the first theory *a*, according to the second, *a girl*. For in the first pregnancy it is absurd, to speak of a contest between man and wife for the transmission of the sex, since the latter has usually scarcely any idea of the act about to take place; and we have already seen in the discussion of the sexual appetite, that the wife has only very rarely satisfaction from coitus right from the beginning, this feeling appearing only after some time in her married life, and most frequently after her first confinement; *thus the wife is in most cases quite passive during coitus*, and therefore the husband must constantly be the prevailing party. Yet everyone is aware, that the first-born is equally often boy or girl. Finally I can positively assert, that it is only in extremely rare cases, that a contest for the sex of the future offspring is waged during coitus. If however anyone is determined to stick to the idea of a «contest», then according to my opinion we can only say: *Coitus is at most a contest for the satisfaction of the sexual appetite, and not a contest for the production of a particular sex.*

While the advocates of the theory of transmission of sex from the same sex simply give the explanation, that the boy, as being the stronger and more vigorous offspring, must as a matter of course be derived from the father.

the stronger and more vigorous parent, and the girl, as a weaker and more tender being, must come from the weaker and more tender mother, the supporters of the opposite theory have brought together a large array of proofs for the correctness of their theory, of which I shall discuss only the principal, in order that the suspicion cannot arise that I intentionally suppress or even deny anything, that has been proved beyond doubt by facts to be correct.

As the principal evidence for this theory of transmission from the opposite sex, of which *H. Janke* [1]) is the most ardent supporter, there is the complaint made by several owners of herds, that in some years in the herd in question only *bull*-calves had been born, and since it was an old bull, which it was possible to bring to act in most cases only by urging him, that served the cows, it was said, that all the cows had prevailed in the contest of copulation, while the bull, which was weak in energy and slow to cover, was considered the vanquished party, and hence it was concluded, that the prevailing party produces the opposite sex. *Figuet* [2]) too considers it quite a common occurrence in every-day experience among numerous herds, that an over-worked bull always begets *bull*-calves only, while in herds, where many bulls are kept, *cow*-calves predominate.

Exactly the reverse of the experiences of the supporters of this theory is found in *Mayerhofer* [3]), who literally says as follows: As long as the ram still possessed his full strength, he begat more males than females; but when a few days later the sheep came in heat in greater numbers

[1]) Janke: o. c. p. 30.

[2]) Düsing, Jenaische Zeitschrift. 1884, p. 610.

[3]) Mayerhofer: Ueber die Entstehung des Geschlechts. Wiener, Mediz. Presse. 1853.

at the same time, and the strength of the ram became more exhausted from frequent serving, then the number of females produced preponderated, and when at last the number of sheep in heat decreased and the period of over-exertion for the ram was over, the production of males again set in.

In illustration of what has been said of the transmission of sex from the opposite sex, we now quote the case of the *stallion Sir Hercules* from the stud of Count Lehndorff. This stallion, when he was in his 26-th year had to serve 23 mares. They gave birth to 24 foals (in one case twins), which were of the male sex, and since it could not be supposed, that the old stallion could be the prevailing party in the contest of copulation, but rather the ardent mares, it was at once naturally inferred, that only the prevailing party in this contest produces the opposite sex. But against this stallion of Lehndorff's Sir Hercules. I venture to contrast the real *Hercules*, renowned through his mythical achievements, for he proved the opposite: he was so strong, that he begat almost without exception boys only, there being among his 72 children only one daughter [1]).

But whoever doubts the existence of a Hercules, and accordingly also takes *Venette's* account to be a pure invention, I can only mention to him an authenticated personage. This is *Gideon*, one of the oldest Hebrew rulers, who was of such a vigorous temperament that he begat 71 boys [2]).

One of the strongest proofs of this Theory b) is sup-

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[1]) Venette: o. c. p. 294; Hercules était si robuste qu'il n'engendra presque jamais d'enfants qui ne fussent mâles et entre soixante et douze, qu'il fit, il ne s'y trouva qu'une seule fille.

[2]) Judges. VIII. 30, 31: And Gideon had three score and ten sons of his body begotten: for he had many wives. And his concubine that was in Shechem, she also bare him a son.

posed to be found in the life-history of the bees, for the queen-bee, *when unfertilised, always lays eggs which become male bees*, and only after having copulated with a male produces female bees. Hence the conclusion was drawn that the female reproductive cells, the ova, possess naturally the potentiality for development into the male sex only, so that, if the opposite influence of the male parent is not exerted, only male offspring will regularly result; in other words, *the ovum is fundamentally and normally designed for the production of male progeny.*

Now if this principle were confined to bees, wasps, etc. there would be no objection to raise against it. When however any one wishes to apply by analogy this theory from bees to all other animals, and therefore also to man, he must remember, *that every observation, that has been made in the lower animals, cannot simply be taken and applied straightaway to animals, of higher, or the highest* organisation for then we would have also to suppose in this case, that the origin of male individuals from unfertilised ova is to be regarded as a generally applicable principle. But that we cannot apply this fact, proved through it is beyond doubt in bees, by analogy to man or the lower animals or even to all gregarious insects, is proved by the following: *v. Siebold* [1]) has positively proved Parthenogenesis in the sack carrying butterflies belonging to the species solenobia and in Psyche helix. The real virgin *solenobiae* lay eggs, which develop quite normally *but always into females*, and indeed females fully developed with fully formed genital organs. In *Psyche helix* only members of the female sex are as yet known so that possibly Parthenogenesis forms in them the only method of reproduction. So too Parthenogenesis exists in Bombyx mori, the silk worm. While

[1]) v. Siebold: Ueber die Fortpflanzung der Psyche. Zeitschrift für Wissenschaftliche Zoologie. Vol. I, p. 93.

the unfertilised eggs in bees produce only males, and in the sack carriers only females we see, that in the silk worm both males and females are produced.

From the mention of this discovery, which *v. Siebold* made, it is perfectly clear, that the non-sexual reproduction in bees cannot be taken as a proof of the theory of transmission from the opposite sex, and accordingly a scientific basis is altogether wanting for this theory.

This is quite enough, to dispose of the whole theory, yet I feel myself induced, to discuss other two circumstances, which seem of the greatest importance to the advocates of this theory, not only because they revert again and again to these cases but because they are facts relating to man himself.

These two cases form as it were the foundation of this Theory and have given rise to its formulation.

Case 1. A robust man of 50 years had a mistress and neglected his wife, a woman 36 years old, by whom he had already had several children, so much that several months would elapse before he performed the duty of matrimony. One night he came home tired out, after he had indulged in sexual intercourse with his mistress to exhaustion, when his wife with caresses craved from him the fulfillment of the conjugal duty, which desire he satisfied, albeit unwillingly and with lassitude. For 4 months before this he had had no sexual intercourse with his wife, nor had he later ever any intercourse with her [1]). In another place the case is described as follows:—a man 50 years of age after he had sexual intercourse with his mistress 4 times in succession, had subsequently coitus with his wife, whom he had neglected for several months, with very poor erection and without the slightest desire, in short at

[1]) Guttceit: o. c. p. 421.

a time, when no seminal fluid is ejected [1]). Yet this woman despite this imperfect coitus subsequently became pregnant and exactly 9 monthes after as reckoned from that date, gave birth to a strong healthy boy, whose resemblance to his father left legally no doubt as to the paternity.

To the supporters of this theory of Transmission from the opposite sex it was quite plain in this case, that *it was the dutiful and passionate mother, that determined the male sex* and therefore produced a boy, *and not the father, who had been exhausted by sexual indulgence.*

Concerning this case, I would remark, that this conclusion, although a bold one to make, might perhaps have some justification, had *Guttceit* pointed out, that during the years in which the wife gave birth to the first children, the husband had had no relations with a mistress, *but had had sexual intercourse with his wife only*, and *that from this intercourse only girls had been born.* But *Guttceit* expressly says «that the wife, whom he neglected (probably also formerly as well) had already given birth to several children». But by «children» I understand, as any other person would, boys as well as girls: indeed, if the children had been all girls, then *Guttceit* would certainly not have omitted, to lay special emphasis on this fact, in order to make the contrast all the stronger.

In my opinion the only proper logical conclusion, which can be drawn from this case, may be put in something like the following terms: *A man, although weakened by sexual intercourse indulged in 4 times in succession, is yet capable of impregnating another woman, with whom he has coitus immediately after, i. e. for the 5-th time, without feeling the slightest sexual desire and in spite of imperfect erection, even in the supposition that in conse-*

[1]) Janke Dr. H.: o. c. p. 40.

quence of the four preceding acts of coitus the whole store of active spermatozoa is almost or entirely exhausted. Any other conclusion and especially such as urges, that a boy must be born from such a coitus, is unwarranted.

Case 2. Concerns a girl 20 years, of age who from her 14-th year menstruated regularly, and had a white discharge subsequent to an attack of typhoid fever, from which she suffered when 10 years old. In 1880 she underwent an operation for an ovarian cyst, which had arisen after the carrying of a heavy trunk. At this operation not only was the left ovary, which was found to be completely diseased, removed together with a portion of its tube but also the whole of the right ovary as well, with the exception of a border of at most 2 mm. breadth, which was left in the abdominal cavity: the right fallopian tube was also left intact. After the lapse of 4 months from the time of operation, her menstruation again appeared. On 23-rd April 1884 she was married and on 12-th May 1885 gave birth to a full-time female child [1]). This example now is taken to prove, that such a radical measure, as the almost total extirpation of the ovaries was, must have so weakened the constitution of the woman or as *Janke* puts it «must have left behind such a debility in the development of the ovum, that in consequence the fundamental disposition of the sexual apparatus to produce a male child was entirely checked». so that the prevailing party, in this case therefore the husband, must produce the opposite sex, here a girl.

Even in this case I can still find no proof, that coitus is a contest, where the prevailing party determines the opposite sex but the only conclusion, that any impartial

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1) Schatz: Gynäkologisches Centralblatt. Vol. IX, No 23. 1885, p. 353.

person can come to, is this: *When in excision of the ovary ever so small a portion of the organ is left behind, not only may menstruation be preserved, but even pregnancy may occur. Whether the child is boy or girl has nothing to do with the operation.* Those who are very interested in these cases may be specially recommended to *Schröder* [1]), *Montgomery* [2]), *Smith* [3]) and *Rheinstätter* [4]), from whom it may be seen, *that after all the larger and more severe operations boys as well as girls are born.* I shall return to this point of this treatise.

So too when fathers, who are in an advanced stage of spinal cord Disease or Consumption, beget more children, these children should according to this theory be always boys. In my own practice I know two families, whose fathers were already suffering from tabes, when they married. The one father had by his wife three perfectly healthy girls within 5 years, and these girls are strong and robust to this day. The second tabetic patient begot first a boy and a year afterwards a girl. As far as consumptive fathers are concerned, I have recorded quite a considerable number of such families, and in them boys are born quite as often as girls. But yet how easily one can put a theory into service is shown by the fact, that according to the views of those, who hold the theory of a Transmission of sex from the apposite sex, the child of the deceased King of Spain had to be a boy, because the father died of consumption!

From all that has been said, it is clear, that *I consider the Theory of Transmission from the opposite sex as inconclusive, nay more as entirely wrong and without any*

[1]) Schröder: Gynäkologisches Centralblatt. 1884, No 45.
[2]) Montgomery: American Journal of Obst. Sept. 1885.
[3]) Smith. A contrib. etc. American Journ. of Obst. April 1885.
[4]) Rheinstätter: Praktische Grundzüge der Gynäkologie. Berlin 1886.

foundation or proof. Yet one would be mistaken to think, that I am a supporter of the theory of Transmission of sex from the same sex for it, too I consider as unsound: on the contrary, I must express my opinion that *neither husband nor wife has a right to be proud when she gives birth to a boy, nor to consider himself or herself vanquished when a girl is born: the determination of the sex must be due to other causes, in which quite simple mechanical conditions as Hegar* [1]) *thinks, probably play the chief part.*

In the discussion of individual theories I will confine myself to the principle, which is formulated to elucidate the theory of the struggle for sex; it runs so: «If the father is in full possession of his generative power and is impelled by strong desire, if the spermatozoa are present in large numbers and their activity is perfectly developed, then the father will determine and produce that sex for which his dominating spermatozoa are primarily designed, viz. the female. And this takes place all the sooner, if the mother on her part shows, that she has at this moment less reproductive power. If on the other hand the mother is *in full possession of her generative power and has very strong desire, and if the discharged ovum is perfectly developed* and in its full vigour is waiting for impregnation, and if moreover her *passion for propagation* both before and during coitus is the preponderant one as compared with that of the father, then in the act of coitus she will decide the issue and accordingly produced a male child» [2]).

Now although the principle just quoted seems to be broader and more definite than the original one anent the

[1]) Hegar: Ueber die Kastration der Frauen. Sammlung klinischer Vorträge von R. Volkmann. No 136—138, p. 1003.

[2]) Janke: o. c. p. 37.

Transmission of sex from the opposite sex, it possesses nevertheless no greater value, it does not matter whether it is applied to Transmission from the same, or from the opposite sex: and this I will at once endeavour to prove.

I have already pointed out, that *the desire for coitus* can have no influence on the determination of sex, otherwise the first born child *would always have to be a boy according to the first theory, and according to the second always a girl, since in a woman we can hardly speak of a desire for coitus at the first impregnation.*

As regards the amount of seminal fluid or of motile spermatozoa, this is an exceedingly old theory, for the old Indian physicians believed, that if the seminal discharge is present in great quantity a boy is born, while if the ovarian discharge is greater, then a girl.

Morello [1]) too says in the same way, that *with a concentrated condition of the spermatozoa male children are born*, while *with a diluted seminal fluid female children.*

Neither has this theory any meaning at all to me, for we know from Physiology, that the number of spermatozoa that must actually penetrate into the ovum in order to produce impregnation, is not only quite small, but even a single spermatozoon is sufficient. *Funke* [2]) says: «As regards the number of spermatozoa that must enter the ovum in order to produce impregnation normally, we cannot say anything with certainty. This appears to vary in different animals, yet in all a small number, perhaps even a single spermatozoon appears, to suffice. *Hertwig* [3]) states in his Textbook of Embryology: «Although large numbers, if

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[1]) Morello: o. c. p. 14: La sperma a più condensato ha affinità al sesso forte, il meno condensato al sesso debile.

[2]) Funke: Physiologie. Vol. II, p. 884.

[3]) Hertwig, O: Lehrbuch der Entwicklungsgeschichte des Menschen etc. Jena 1886, p. 30.

the seminal fluid is rich, many thousands of spermatozoa, attach themselves to the gelatinous envelope of the ovum, *yet only one of all this number impregnates it*, viz. the one, which has reached the ovum first by means of the lashing movements of its tail»; and *Landois* [1]) says equally distinctly: «The ovum is impregnated by the passage of **one** spermatozoon into it».

In spite of the physiological fact those, who support the theory of the influence of a large number of spermatozoa, stick to their own opinions and indeed go so far as to refer to *Pflüger* [2]) who, they think, considers it conceivable *that impregnation with a large number of spermatozoa gives rise to males, while with a small number passing into the ovum it produces females*. Yet of one turns to Pflüger himself, no such conclusion can be drawn from his work. He has, it is true, carried out a large series of experiments to ascertain the influence, which the concentration of the seminal fluid exercises upon the sex. According to *Pflüger* there are normally developed among frogs in their natural state 36·3% males and 63·7% females. With concentrated seminal fluid he got from 492 frogs 194 males i. e. 39·4%, and 298 (60·6%) females: with diluted semen he found out of 209 frogs 57 (27·3%) males and 152 (72·7%) females. When one takes into account the contents of 21-th Aquarium, in which out of 72 animals there were only 8 males and 64 females, there yet turns out in spite of the diluted semen a proportion in favour of the males, viz 49 : 88. A third series of experiments with a watery extract of the testicles of frogs, which had just finished from the spawning season, yielded out of 105 frogs 37 males and 68 females i. e. 35·2% : 64·8%.

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[1]) Landois: Lehrbuch der Physiologie 1888—9.

[2]) Pflüger: Zur Frage der das Geschlecht bestimmenden Ursachen. Archiv für Physiologie. Vol. 26. 1881, p. 243—258.

From all these three series of experiments with concentrated and diluted semen, and watery extract of testicles it is proved *that neither concentrated nor diluted seminal fluid nor watery extract has any influence upon the sex*, and if any one will admit its existence at all, it is according to *Pflüger* so small, that it cannot be demonstrated with certainty.

With regard to the *full generative power* of the woman I really do not know, what is implied by this expression. If a woman menstruates regularly and otherwise suffers from no disease of the generative system, then she is in my opinion in full possession of her generative power, and since such women give birth to boys just as well as girls this generative power has no significance whatsoever in the determination of the sex.

As to the *full generative passion* of the woman I have already shown, that it can only rarely have effect at the first pregnancy, indeed I can with full assurance assert, that those women, who have already had several children and moreover derive real pleasure from coitus, have absolutely no passion for conception, nay on the contrary submit to their husbands with great fear and dread lest pregnancy supervene, and yet we see, that one and the same person in this category gives birth to boys and girls alike.

As to the phrase «*perfectly developed, discharged ovum, which is waiting for impregnation*». I must remark, *that it is only a fully developed and discharged ovum, that can be impregnated*, for no one will surely suppose, that the spermatozoon *penetrates into the ovary*, and will there fertilise an ovum that is not yet mature. There is most likely here a misual of the expression, since by a fully discharged ovum there is possibly meant the influence, which the interval between the menses exerts on impregnation. I think therefore, that we are to understand the

matter thus, that the relations to menstruation in reproduction are to be considered according as the impregnation takes place at different times during the menstrual interval, and as matter of fact there is a large array of theories, which would make the determination of sex dependent on the menstrual intervals.

Menstruation.

According to *Kundrat* and *C. G. Engelmann* the mucous membrane of the uterus, about which we only know, as has been already mentioned, that it becomes swollen at the time of menstruation and the tubular glands appear most distinct, is swollen to twice its thickness already 10 days before the menses set in: this swelling reaches its maximum during the discharge, and afterwards sinks down until in 9 or 10 days after the onset of menstruation the mucous membrane, according to *Hensen*, is completely renewed in order to swell again a few days after and repeat the same course.

Hence the conclusion was considered warranted that in the last days preceding the onset of menstruation, when the whole generative system is affected in a high degree out of sympathy, the impregnated ovum must also be thereby affected, and from this cause proves itself, to be less inclined in the contest with the spermatozoa taking place at this time to try to determine the sex of the future child. Still less qualified however, it is said, is the ovum to do this at the time, when the process of expansion in the mucous membrane has reached its maximum, i. e. while the discharge lasts.

According to this theory therefore it is at this time above all others, that female children will be produced; but if the mucous membrane has returned to its normal condition after the menstruation, and this takes 4—5 days,

then the ovum becomes capable of prevailing over the seminal fluid and of producing children of the male sex.

Here too we find, that *Hippocrates* [1]) attached a certain weight to menstruation: «If a boy is to be produced, the husband shall have coitus with the wife, when her menses are quite or nearly over, and go in as far as possible; while if he wishes to beget a girl, he shall have coitus, when the wife is in the middle of her menstrual period, or the flow is still going on. In explanation of this theory I can do nothing better, than to quote from the Talmud to which reference is made and some of the practical experiences of breeders and physicians armed as they are with a large mass of statistics from which some assert, that in the first days following menstruation only boys are conceived, and later i. e. in the last days only girls: while others just as positively hold out, that only female ova are impregnated in the first 10 days of the menstrual interval, and only male ova in the last days.

A main support for this theory is supposed to be found in the law of the Talmud, according to which among very orthodax Jews 7 days must elapse after the menstruation, before coitus may take place and it is said to be due to this law, that the percentage of male births among the Jews is unusually large. It is just after the elapse of so many days from the end of a period, that the discharged ovum is supposed to be in the fulness of its normal strength, and its resistance against the influence of the spermatozoon accordingly just at this time the very strongest. As regards the law of the Jews, it is quite exact and runs thus [2]).

[1]) Hippocrates: De superfoetatio. Cum marem procreare volet, mensibus desinentibus aut cessantibus uxorem adeat it quam penitissime intrudat cum semen excernat. At ubi feminam generare volet, cum plurimi menses muliebri fluxerint, necdum cessarint.

[2]) Leviticus, XV, 19 and 28.

«If a woman have an issue and her issue in her flesh be blood, she shall be put apart seven days»; and further,— «if she be cleansed of her issue, then she shall number to herself 7 days and after that she shall be clean». The conclusion drawn however is a false and quite arbitrary one, for the lawgiver had not a thought about the production of boys, as the Talmud also shows:—Rabbi Izchak said in the name of the Rabbi Ami: A wife becomes pregnant only about the time of her menstruation. A wife becomes pregnant only a short time after the bath (The 7 days shall be observed etc.) because the husband accustoms himself to his wife, he becomes tired of her; therefore she shall remain unclean 7 days, that she may be beloved of her husband just as at the hour when she went under the wedding canopy» [1]).

As regards the statement of the extraordinarily high percentage of male births among the Jews, that is by no means proved, and as far as I know, there exists no statistical record, that furnishes proof of this. For the few data that exist, and these we find best given in *Düsing* [1]), show, that in *Prussia*, for example, between 1824—34 the proportion of male to female births among the Jews was as 110 : 100, while for the period 1849—52 it was 106 : 100; in *Sweden* between 1851—55 the ratio was as 108 : 100.

Although we can draw up no definite law from these figures, we must yet not forget to consider, whether we are really dealing with orthodox Jews here, and this I doubt very much. If it were really due to their strict religious observance, that the Jews have more boys than girls, then how would this fact be explained, that among

[1]) Dr. Wünsche, Der Babylonische Talmud. Leipzig. 1889. Tract. Niddah. Chap. 20, p. 187.

[2]) Düsing: o. c. p. 592—940.

illegitimate births the proportion of males to females is 118·6 : 100 and in Austria even 123 : 100? No one will be willing to maintain, that in these pregnancies much respect was paid to the strict Mosaic law. A closer acquaintance with the conditions of Jewish families shows me, that the proportion of male to female births among them in no way departs from the normal. To be sure, I will admit, that the Jews known to me were not orthodox. Even if the percentage among the orthodox Jews were an extraordinary one in favour of boys, yet the conclusion cannot be drawn, that the reason for this is to be found in the faithful observance of the strict Jewish laws. *No man, be he free thinker or orthodox, bothers himself about religious precepts, when the sexual desire appears*, as the French say: «Quand nous sentons les éguillons de Venus». Probably others besides myself will be acquainted with very strict Jews, whose wives were confined at a time, which must correspond to the conception taking place during the great Fast i. e. during a time when sexual intercourse is forbidden.

Yet how little religious principles are taken into consideration may be seen among the simple folk in Russia who are nevertheless on the whole very religious.

For among them the births do certainly diminish in number nine months after the beginning of the Fast, but not at all in the same proportion as one might expect: much less do they cease altogether at this time.

From a compilation of the births in the Moscow foundling Hospital within three years, the individual months give the following figures: January 1045, February 1010. March 874 [1]), April 928, May 1086, June 1159, July

[1]) The low March number corresponds to the Fast of the preceding June.

1072, August 1076, September 876 [1]), October 963, November 976, and December 884 [2]).

According to Wilson the development of the sex depends on the condition of nutrition of the ovum at the time of impregnation. The ovum, that is impregnated before menstruation, is stronger, and tends to develop into a male and if impregnated after menstruation, it is weaker and tends to grow into a female. The longer the impregnation of the ovum is delayed after its discharge from the ovary, the more likely will a female embryo be developed, and vice versa.

We shall now examine somewhat more closely the proofs brought forward by breeders and physicians.

Heat.

Thury [3]), a breeder of much experience, convinced himself with regard to copulation among the lower animals, that *when cows were covered at the beginning of the period of heat, they produced cow-calves, and if at the end of the period — bull-calves.* Although there are breeders, whose opinions go exactly against these statements of Thury, and therefore the whole theory collapses, yet I shall not omit, to draw special attention to one fact. Even if all breeders were agreed, that female animals are produced at the beginning of heat, and males at the end, I should not consider, that this law was applicable to human beings straight away, because *the conditions attending heat among the lower animals are quite different from*

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[1]) The low September number corresponds to the Fast from 14 Nov. to 24 Dec.

[2]) The low December number corresponds to the great Fast from February to Easter.

[3]) Thury: Ueber das Gesetz der Erzeugung des Geschlechts. Leipzig. 1863.

those in man: for while in the former it sets in differently according to the species and runs its course in a comparatively short time, it continues in women from puberty to the climacteric, and in men often to the end of their life.

Men show no interruption in the activity of their reproductive glands by periods of rest, and no periodic«heat» coinciding in time with menstruation in the female. So too a woman may in spite of her periodic discharges become pregnant after coitus at any time, not only during menstruation but indeed midway between two periods.

Morello [1]) asserts, that coitus between married people *after the menstruation is past produces boys, but if before the beginning of the period—girls.* He is not satisfied merely to pronounce this general rule, but he goes so far as even to set definite days, and to describe exactly the procedure for coitus: «after an abstinence of 5 days, during which the husband has had no sexual intercourse with any woman, he may have coitus with his wife on the 8-th day after the appearance of her menstruation in the morning, shortly before rising and only once, to beget a boy. They must then abstain from all intercourse, and

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[1]) Morello: o. c. p. 24: *Per creare un maschio.* Dapo una astinenza di cinque giorni que l'uomo non avra avvicinato a nessuna donna, usa la sua donne da concepire una volta sola nel 8º giorno dapo la comparsa del menstruo replica la mattina levandosi e asternazsi i dui conjugi per ritornare ad usare un altra sola volte nel giorno 12, e poi nel giorni 15, e poi nel giorni 18. E sempre eosi ogni mese usare la donna in questi soli giorni, finché sarà concipata. e raccomando al nomo que durante il tempo del cinque giorni prima del giorno 8 sin al giorno 18 che reusa la sua donna non accostarsi a nessuna altra donna". *Per creare una femina.* Usare la donna in cominciando 10 giorni prima la compasso del menstruo e sforzando una volta ogni, sei o otto ore, e secondo il temperamento debol dell'uomo onche ogni 10 ore, e cino sine il giorno di questa compassa. E sempre casi periodicamento in questi soli giorni usare la donna, finché sarà conceptà".

she must have coitus not before the 12-th day for the second time, and this time too only once. and then again on the 15-th and 18-th days. In this way the husband must embrace his wife but only on those set fixed days, and continue thus until his wife becomes pregnant. To beget a girl the husband shall embrace his wife every 6 or 8 hours, beginning on the 10-th day before her menses appear, and if the weakness of the husband debars him from so frequent intercourse. only every 10 hours. He shall continue these duties of matrimony in the manner described until the beginning of her menstruation, and observe this rule from period to period, till his wife has conceived». But if he does not want to have any children, he may have intercourse with his wife only on the 16-th, 17-th, 18-th, 19-th day after the end of a period, for in these days a woman never conceives».

Avicenna [1]) (980, A. D.) must be looked upon as the founder of this theory, according to which the days between two menstrual periods are supposed to have an influence on the sex. for he says: «From the 1-st day of menstruation to the 5-th a woman conceives male children. from the 5-th to the 8-th female, while from the 8-th to the 12-th again boys. and from the 12-th to the next period hermaphrodites.

The observation made by *Morello*, agrees pretty well with that of *Venette* [2]). He asserts. that irregular and too

[1]) Avicenna: A primo purgationis die numerando ad quintum usque generat femina marem, a quinto ad octavum femella, ab octavo ad duodecimum iterum marem, a duodecimo usque ad futuram purgationem androgynes.

[2]) Venette: Tableau de l'amour conjugal. London. Les jeunes gens qui dans les premiers jours de leur mariage se caressent si éperdûment, qu'ils n'engendront point de tout, ou s'ils engendrent, ce n'est ordinairement que des filles. Mais si un homme ne caressait sa femme que trois ou quatre fois le mois la semence aurait plus de disposition à former un garçon que si on l'épaudrait plus souvent.

frequent sexual intercourse is injurious; all young married couples have on account of their frequent intercourse either no children at all, or only girls, because he thinks, that the seminal fluid of the husband becomes exhausted and the wife gains the ascendancy: but if sexual intercourse takes place only 3 or 4 times in the month, then the seminal fluid is more fitted for the production of boys, than when it is more often used up.

In opposition to what has been said above is the remark which we find in the *Talmud*[1]). *Rabbi Ketina*, the Small, says: «Who ever wishes to have male children must have coitus with his wife, twice in immediate succession, for *Raschy* teaches, that the wife excited by the first embrace is ready for the second before the husband, whereby a male child is conceived. But here one might very well ask, why it is always in the 2-nd and not the 1-st embrace, that impregnation should take place? On the other hand *Bock*[2]) asserts, that sexual intercourse, which is indulged in many times in succession favours the production of girls and accordingly advises, that when a man wishes boys, he should only seldom have intercourse with his wife, till pregnancy supervenes, while in order to have girls, he should have coitus oftener, every one to two days. *Robin*[3]) also maintains, that the more women keep aloof from intercourse with men, the fewer female children do they have, and that those women, who are most prolific mostly give birth to boys.

Leuchs[4]) takes up a position exactly opposite to that

[1]) Wünsche, Dr. I Tract. Niddah, p. 186.

[2]) Bock: Das Buch vom gesunden und kranken Menschen. 1889, p. 656.

[3]) Robin: Memoire sur l'art de faire produire le sex, que l'on désire. Paris. 1875.

[4]) Leuchs: Knaben oder Mädchen. Nürenberg. 1876.

of Morello and his followers. He makes out. that the female sex attains its maturity before the male and therefore the female ova become sooner ripe than the male and hence also sooner capable of impregnation. Since moreover every 4 weeks during sexual maturity such a discharge of unimpregnated ova, which requires 3—7 days takes place, there remain over 21—25 days for the impregnation of mature ova. Accordingly in the first 10—12 days female ova become mature, in the last 10—12 days male, and towards the end of the last days male ova may appear again.

Dartigues [1]) states, that if conception occurs one or two days before, or immediately after a period. a daughter will be born; but if two or three days after the end of a period, then a son.

From this small number of observations. which might be enlarged considerably. it is seen *that the whole theory of the menstrual interval rests not on physiological facts but purely on a priori subjective views*, for we at once see the contradiction, which springs up in it:—*If some think, that impregnation during the first days after a period is specially suited for the production of boys, while others think for the production of girls, then we must come to the conclusion, that the days in the menstrual pause can have no influence at all on the determination of the sex, for it is absolutely impossible, that one and the same cause (the days) can produce two diametrically opposite results (boys and girls).*

The improbability. nay the lack of substantiation of this theory, that the first days after a period should determine the sex, should have been I think at once apparent to all, for with any ordinary married couple, where husband and

[1]) Dartigues: De la procréation volontaire des sexes. Paris. 1882.

wife occupy the same bedroom, they will have sexual intercourse certainly in the first days, if not actually the first day, after her menstruation is past, and therefore according to the opinion of some the preponderance of male births, according to others, that of female births, would have to be disproportionately great, nay even enormous, which however is not the case at all. Moreover the theory of *Morello*, *Leuchs* and their adherents seems to me, to have been thought out in the sanctum rather, than to be based upon a large practical experience, for I am not satisfied, how the day of conception can be fixed with certainty. That would only be possible if the cases were collected, where pregnancy took place after a single coitus, or the wife could quite definitely name the day of of conception, or lastly, where about 280 days after the marriage a child was born. But pregnancy after a single coitus is relatively such a rare thing, that it would be more than daring, to draw a conclusion from this small amount of material on this important question, as *Baust* [1]) with his 14 cases and *Schwift* [2]) with 20 do.

Besides I must remark, that their accounts do not show, that they arrived at their conclusions on the basis of a single impregnation.

Quite as rare are those cases to be regarded where the wife was able to say exactly, at what time she had been impregnated, when she had had sexual intercourse several times within one menstrual interval, although I hold that this is possible in a few cases.

In the cases, where the birth of a child occurs about 280 days after a marriage, it would be indeed easier, to prove the influence of the days, if such were to be ad-

[1]) Baust: Die Ursachen, welche die Entwickelung etc. Stuttgart. 1891.

[2]) Schwift: Boston med. and surg. Journ. 1878.

mitted at all, since in the vast majority of cases the marriage is celebrated shortly after the menstruation of the woman. But yet even in these cases it would have first to be proved, that it was positively the first, and not perhaps the fourth. fifth, or later coitus, in which the wife was impregnated.

In this matter there fortunately exists no statistical record, so far as I know; and even if there were any such, one would only get the same results with it, as with all the other statistics relating to the determination of sex.

To show, however howfar people may go with speculation, to determine the law for the production of boys and girls, I might mention only as a matter of curiosity, that there are even people, who have given the hours, in which boys and girls respectively might be produced. Thus *Cook* [1]), for example, says, that boys are conceived at night before midnight, while girls are conceived in the morning. I can only agree with *Venette* [2]) when he says: «Le jour n'a rien de facheux, ni la nuit rien de favorable pour l'amour; au reste le matin serait le véritable temps de nous embrasser. Il ne faut pas observer ni le jour, ni la nuit, ni les heures, ni les moments, mais la disposition, dans la quelle nous sommes».

We only want however some one to take the different days of theweek to prove, that on certain days boys, and in certain others girls, are produced: a thing, which it would not be difficult for a speculative mind, to accomplish, for statistics are but a Science, by which one can prove every thing, if one wants to prove any thing à tout prix.

After this remark, I think, I have sufficiently appraised the influence of menstruation and the menstrual inter-

[1]) Cook: Nouvelles Archives d'obstétr. et gynaekol. July 1887.
[2]) Venette: o. c. p. 109.

vals upon the determination of the Sex, *as I consider this influence as absolutely not proved and non-existent.*

After menstruation I will discuss some other causes, which are said to determine the Sex, of which I mention only those generally current and recognised, such as the relation of age, nutrition, climate, will power, generative passion etc.

A g e.

There are many, who would like to ascribe very particular influence on the sex of children to the relation, in which parents stand to one another with regard to age, and the founders of such a theory are *Hofaker* [1]) in Germany, and *Sadler* in England [2]). These two men proved at about the same time by statistics that (1) if the husband is older than the wife—more boys than girls are born as a result of the marriage, (2) if both are of the same age, then somewhat fewer boys than girls, and lastly (3) if the wife is older than the husband, there are more girls than boys.

It is not to be wondered at, that this theory at once found its adherents and opponents in great numbers, and even up till quite recently claimed some supporters, but there is also not a very small number of those, who accept the facts in this theory as correct, but consider the conclusions drawn from them as false, as I will presently show. In the first place I have to mention the name of *Schlechter* [3]) the most important supporter of the Hofaker-Sadler theory. He found on examining a collec-

[1]) Hofaker: Ueber die Eigenschaften, welche sich bei Menschen und Tieren auf die Nachkommenschaft vererben. Tübingen, 1828.

[2]) Sadler: The law of population. London, 1830.

[3]) Schlechter: Die Trächtigkeit und das Geschlechtsverhältniss bei Pferden. Revue für Tierheilkunde u. Tierzucht. 1882. № 6—9.

tion of 69000 marriages for the period between 1798—1879 that where both parents were in middle life—female births were much more numerous, where both parents were advanced in life—male births preponderated; and as a rule the older the father was, the greater was the increase of male births, while if the mother was the older of the two, the number of female births rose considerably.

Another supporter of the Hofaker-Sadler theory, *Wall* [1]), says indeed, that the age as such cannot affect the difference in sex, yet he puts forward the opinion that, if both parents are in the prime of their sexual maturity, the influence of the father to beget boys is stronger, than that of the mother, but if the husband is only a little above or below this stage, the wife with her influence towards girls proves herself the stronger — in other words, where the husband is considerably older than the wife, an excess of male births occurs.

As one of the first and at the same time foremost opponents of this *Hofaker-Sadler theory* we must mention *Girou* [2]), a French breeder, who in virtue of his numerous observations comes to a series of conclusions, of which I pick out only the following: — 1) Young married men beget more daughters than sons; 2) Men in advanced years beget more sons than daughters; 3) Men, who have married more than once, have in the second or third mar-

[1]) Wall: Some consideration in regard of the causation of sex. The Lancet. London. Jeb. 1887.

[2]) Girou: De la génération. Paris, 1838.

1. Ceux qui se se sont mariés jeunes ont eu plus de filles que de garçons.

2. Ceux qui se sont mariés dans un âge avancé ont eu plus de garçons que de filles.

3. Ceux qui ont eu plusieurs femmes ont eu un plus grand nombre relatif de garçons des deuxièmes, troisièmes lits.

4. Ceux qui ont épousé des veuves ont eu plus de filles que de garçons.

riage more boys than in the first; 4) Men, who marry widows, have more girls than boys. From these statements it is seen, that Girou, like Hofaker and Sadler, attaches considerable importance to age for the determination of the sex; he only differs from them in this that, where as he takes up the view of Transmission of sex from the opposite sex, they profess to be supporters of the theory of Transmission from the same sex. What I have already remarked on the discussion of the relations to menstruation, repeats itself here exactly viz. *that one and the same cause according to one view holds good only for the reproduction of boys, and according to another view may be applied only for that of girls. Girou* again differs from *Hofaker* and *Sadler* in so far, as he makes use of the influence of character, nutrition etc. besides the relation of the parents ages in order to make his theory acceptable. He says [1]): — 1) Men of strong character, be it good or bad, beget more girls than boys; 2) Men of weak character, who marry women of a firm mind, have more boys than girls; 3) Men, who marry women of especially strong character, beget more boys than girls, and lastly; 4) Men of great proportions, who are big and stout have more boys than girls.

Of the more recent investigators *Bidder* [2]) agrees most with the views of Girou, in that, he too considers the

[1]) Girou. o. c.

1. Les hommes d'un grand caractère, qu'ils aient été vertueux ou pervers ont eu plus de filles pue de garçons.

2. Les hommes faibles de caractère ont eu plus de garçons que de filles.

3. Ceux qui ont épousé des femmes d'un grand caractére ont eu plus de garçons que de filles.

4. Les hommes grands de taille ou gros et gras ont eu plus des garçons que de filles.

[2]) Bidder: Ueber den Einfluss der Mutter auf des Geschlecht des Kindes. Zeitschrift für Geburtsh. u. Gynaekol. 1878. Vol. II. Pt. 2.

age of the mother as determining factor of the sex of the child and advances the opinion, that very young primiparae give birth to many boys, while primiparae in full maturity, 20—21 years old, have more girls than boys: then from this time onwards the number of boys decreases considerably with the increasing years of the mother, but the older the primiparae are, the greater is always the excess of male births.

Further, we have to mention *Eckhardt* [1]), who in Schroeder's clinic found out of 543 cases the excess of boys greater in primiparae 30 and 40 years old, than was the case among primiparae at other ages; but in primiparae over 40 years of age the number of female births is in excess.

Ahlfeld [2]) too has found, that elderly mothers have more boys than girls; in 102 births there were 59 boys and 43 girls i. e. 137 : 100. According to *Hecker* out of 432 births there were 247 boys and 185 girls=133:100. *Schramm* has out of 16346 cases 1038 married women, elderly primiparae of 28 years and upwards, who had 584 boys and 471 girls i. e. 124 : 100; on the other hand we find in 439 families with 1376 children, where the fathers were from 10 to 50 years oldor than the mothers, 682 boys and 694 girls, = 49·5 : 50·5. With a difference of **10 years** there were **168 boys** to **165 girls**: with a difference of **11 years 90 boys** to **117 girls**, and with a difference of **12 years 103 boys** to only **84 girls**.

From all these figures we may really draw the conclusions first, that elderly primiparae give birth to more boys, and second, that when the husband is much older than the wife more girls are born. But the aspect is

[1]) Eckhardt: Ueber alte Erstgebärende. Inaugural-Dissertation. Berlin 1887. Zentralblatt für Gynäkologie. № 40. 1887.

[2]) Ahlfeld, Zentralblatt für Gynäkologie. Vol. IX. 1876.

at once changed if instead of taking the average of every age (since in the later stages of life too few examples are forthcoming, which therefore do not admit of any reliable practical conclusions) we compare single years, or two, or tree stages of life with one another. Then we find from *Schramm* that where the mother was *10 years* older than the father there were in seven families *9 boys* and *7 girls*, but where she was *11 years older* there were *7 boys for 13 girls*. But where the husband was *11 years older* than the wife, then for *90 boys* there were born *117 girls*, where he was *12 years older*, only *83 girls* for *103 boys*. In spite of all statistical proof it is not easy to imagine, *that a single year could make such an immense difference and that through this one year such an extraordinary change should take place.*

But I dont think, I can better demonstrate the utter invalidity of all theories, that are based on the relative or absolute age of the parents, than by repeating, in conclusion, the relation of sex of the children to the age of the mother, as reckoned up by the statistical bureau of the city of Berlin. According to its calculations there are more female births among women of 21, 24, 26, 34, 38, 42, 48, and 49 years of age, while the male births are more numerons among women 17, 18, 31, 33, 37, 40, 45, 46, and 51 years old.

One has only to look at these figures with an unprejudiced mind in order to convince oneself, *that the whole of this theory, supported though it be by a large array of facts is nothing more, than a piece of arithmetical juggelery, without the slightest scientific merit, or a grain of practical value, for as a matter of fact boys as well as girls are born at all possible ages of parents.*

For almost 50 years the *Hofaker-Sadler* theory held its ground in spite of the contradictions to be found in it,

and it was only by the labours of *Stieda* [1]), *Berner* [2]), and *Birelli* [3]), that it was exploded, for they proved, the first for Germany, the second for Norway, and the last for Sicily, that not even by statistics is it possible to prove, that the relative or absolute age of the parents has any influence whatever an the sex of the children. *Wilkens* [4]) too had even before them adduced the proof from the domestic animals, that the formation of sex does not depend at all on the age of the sire, and just as little on the sexual energy or the age of the reproductive elements.

Although the theory that refers the determination of the sex of a child to the days in the menstrual interval is a false one, as I think, I have already proved, it has at any rate this one merit in itself, that it can be at once, in case it were correct, practically utilised for it would be only necessary, to have sexual intercourse in the first eight days after the menstruation, or in the last eight prior to its onset, according as one belonged to the party, that believed in the conception of boys in the former period and of girls in the latter, or to the party, that held just the opposite views. Yet nothing of a practical use in life is to be expected from the theory, which makes the determination of sex dependent on the age of the parents, even were it perfectly correct, for nobody can make himself a certain number of years older or younger, and in contracting a marriage people look to something else than to whether the man is so many years older or younger than the woman *and whether*

[1]) Stieda: Das Sexualverhältnis der Gebornen. Strassburg 1875.

[2]) Berner: Ueber die Ursachen der Geschlechtsbildung. Christiania 1883.

[3]) Birelli; Il Morgagni. Vol. VII. 1884.

[4]) Wilkens: Thiel's landwirthschaftliche Jahrbücher Vol. XV. 1866. p. 654.

the relation of their ages to one another is as it is called a physiological one.

How little value one can set upon mere statistical records, and how carefull one must be in drawing conclusions from figures is illustrated by the example of the influence, which some have wished to attribute to a narrowed pelvis in the causation of sex.

Olshausen [1]) states, that in the clinic of Halle there were born of 521 women with narrowed pelvis 211 girls to 301 boys, = 100 : 147. *Linden* also investigated this subject, and found, that in cases of narrowed pelves for every 100 female births there were 133 male—in rickety pelves 150, in generally contracted pelves 143, and in simple narrowed pelves 106 male births. Of these figures *Olshausen* himself says, that such peculiar facts have been found out in the sphere relating to the development of sex, that one cannot be surprised, if some other inexplicable fact is established.

From the figures, that have just been given, one would have to conclude, that a wife that is weakened through illness is not capable of continuing her own sex in her children and accordingly gives birth to more boys, in the proportion of 100 girls to 147, 133, 143, and even 150 boys. Such a conclusion, which goes strongly against the theory of the Transmission of sex from the opposite sex, would however only be justified, if the proportion of male to female births generally in Halle had, also at the same time been mentioned, without taking into consideration the state of health of the mothers. I am convinced, that in this case amongst the births generally the proportion of boys to girls will be almost the same as in cases of contracted pelves, in other words, that this is a purely local phenomenon,

[1]) Olshausen: Klinische Beiträge 1884.

and that this is the case is proved by *Dohrn* [1]) from the journals of the clinic in Königsberg. He found, that of 450 women with contracted pelvis there were born 224 girls to 226 boys i. e. about 100 : 101; in 237 cases of rickety pelvis, 115 girls to 122 boys i. e. 100 : 106; and n 213 cases of generally contracted pelvis 109 girls to 104 boys = 100 : 95. If we take all these cases together, we get proportion of 448 : 452 (or 100 : 101), a ratio, which must be looked upon as normal for Königsberg, since *Dohrn* found, that in all other births the relation of males to females was 100 : 101 · 6.

Although we can set no practical value on any of the theories yet discussed, we cannot refuse them a certain justification, or if one may so say a raison d'être. But, what are we to expect from the influence, which is attributed to nutrition, certain diseases, the temperament, passion, will, and climatic conditions? I must anticipate my reply by saying that *there is absolutely nothing to expect*, and yet I must mention some of these influences with a few words, since they are involved more or less in all theories.

Nutrition.

That an animal will be the more prolific, the better its nutrition, provided other things being equal, is a statement the truth, of which it would be hard ever to doubt. But how anyone can find in it a factor, that influences the sex is a thing, I cannot understand.

In this matter also *Heippocrates* [2]) is to be regarded as

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[1]) Dohrn: Zeitschrift für Geburtshilfe. Vol. XIV. 1894. p. 80.

[2]) Hippocrates, De victus ratione Bd. I. Chap. X. Si igitur feminam procreare animum est, victus ratione ad aquam tendente est utendum. Si vero marem-victus ratio ad ignem spectet instituenda est. Ac neque solum quod a viro excernitur in crementationem aptum est, sed etiam quod a muliere istam sane ob causam. Neutrum quidem per se sufficien-

the first to consider the influence of a certain mode of life upon the formation of sex. He says: «If therefore it is desired to have female children, one must keep more to a watery diet, while if male children are desired, one must take a diet, which inflames, and this not only the husband but also the wife must attend to. For not only that which is secreted by the husband is fitted for growth, but also that which the wife secretes; but since neither of the two has sufficient movement in itself to consume the amount of moisture that flows in, they both die from the weakness of the fire when however they both come together into one, then the two elements fuse into one another fire into fire and water into water».

A proper estimate of the influence of nutrition has been, I think, given by *Venetté* [1]), as follows: — «The mode «of life influences most the blood and the juices. Yet it «is not at all necessary to eat and drink immoderately, when «it is desired to produce a boy».

In this century *Bellingeri* [2]) brought forward a theory on the influence of nutrition on sexformation. According to him, the warm climate and seasons, food, which warms the stomach, the blood and flesh, especially when raw and from such animals, as in their turn feed on red warm blood, further alcoholic beverages, in short everything that warms the whole system and has the effect of coagulating the albumin in the body has the tendency to give women a greater vigour for copulation and thereby favour the

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tem habet mutatione, ut am fluentem humoris copiam absumat, sed ex ignis imbecillitate concrescit. Cum vero in unum ambo convenerint in sese mutuo incidunt, igna ad ignem, aqua eodem modo.

[1]) Venetté: La manière de vivre est une des principales causes du sang et des humeurs. Mais il n'est pas besoin de manger ni de boirs beaucoup et contre temps, quand on a dessein de faire un garçon.

[2]) Bellingeri: Del influenza del cilo e della bevanda sulla fecondita. Torino. 1840.

production of females. On the other hand the cold or temperate Zones and seasons, a cooling diet taken from animals with red and cold blood and above all a vegetarian diet, especially made up of fruit and vegetables, and as a beverage fresh clear water, in a word everything, that increases the bulk produce in men a greater power of reproduction and effect an excess in the number of male births.

Next to Bellingeri comes *Wilkens* [1]), who from a large mass of statistics collected from horses, cattle, sheep, and swine came to the conclusion, that the formation of sex in the lower animals is dependent on the nutrition of the uterus in this way *that better nutrition of this organ favours the formation of female progeny, while poorer nutrition favours males*, yet at the same time he cautiously adds, that *besidis the variations in nutrition other unknown influences are in force*, since the same dam in the same condition of nourishment does no always produce the same sex. Although it must be said at once, that nutrition has absolutely no influence on the sex of the child to be conceived, least of all as Wilkens supposes, on the sex of the embryo lying in the uterus, there have yet been people, who wished to bring this theory into actual practice by proposing that, for example, in order to beget a boy, the husband should not only keep to a spare diet, but should also indulge in sexual intercourse to exhaustion (I ask here, with whom?) before the deciding act of coitus with his wife and thus impair his power of generation in order, that in this contest she may give birth to a child of the opposite sex to her i. e. a boy. But in order to prevail in this contest the wife must on her part take a strengthening stimulating diet must keep herself aloof from sexual intercourse for a

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[1]) Wilkens, Thiel's landwirtschaftliche Jahrbücher. Vol. XV. 1866.

considerable time, etc. I can demonstrate the impractibility, nay more the absurdity, of this proposal by mentioning, that for the production of a girl these «practical» men propose, that both husband and wife should do exactly the reverse to what was advised for the production of a boy, viz. that the wife should weaken herself by excessive sexual intercourse! (here again I ask, with whom?) and the husband by abstinence therefrom and by good, strong, stimulating food should strengthen himself for coitus with her.

Of course there are also opponents of this theory, who at once declare, that with such a procedure exactly the opposite result to that, which the above theory affirms, must ensue.

Mayerhofer (1) amongst others says: The sparing of the seminal fluid by infrequent coitus probably favours the formation of male sex at conception. *Martigoute* (2) also remarks: If the ram is over-worked he begets more female lambs, but if he possesses his full strength as at the beginning of the breeding season, then more males are produced.

At this point I cannot allow to pass unnoticed the theory of *Schenk* (3), which has recently caused so much sensation. In the first place Prof. Schenk professes himself a supporter of the theory of Transmission from the opposite sex, although those authors, to whom he refers, are adherents of the theory of Transmission of the same sex. As regards his theory it is chiefly based upon the state of nutrition of the mother. It is true, he mentions the observation of *Wappaeus*, according to which the good or

1) Mayerhofer: Archiv für Gynäkologie. Vol. IX. 1876. p. 443.
2) Martigoute, Constatt. Jahresbericht 1860. Div. 6, 7. p. 5.
3) Prof. L. Schenk: Einfluss auf das Geschlechtsverhältniss. Magdeburg. 1898.

the bad nutrition in different fruitful years in Sweden *has on special influence* in making the one or the other sex excess (p. 61). The state of nutrition, therefore, can be of no, or at most of only minor significance in the determination of sex. Nevetheless *Schenk* thinks, he can explain the different results on the ground, that in the xperiments no notice was taken of the excretions, for he ound in his cases, that the presence or absence of sugar the urine is the most determining sign for the sex of the child, since the children of those women, who excrete sugar, belong mostly to the female sex. I will not go urther into this theory here, as I have already discussed t in the «Aerztliche Rundschau» of 28th May 1898, no. 22.

It appears to me most remarkable, that a *physiologist* should refer the differentiation of the ovum into the male or female sex to the end of the third month. It is quite true, it is only at this time, that the difference of sex can be made out *macroscopically,* yet one expects a man like *Schenk* to know that even in the first stage primordial seminal cells and primordial ova are distinguishable, a circumstance to which *Strassmann* [1]) properly calls special attention. Since I will speak later on about primordial spermatic cells and ova, I will just remark here, that the new theory of *Schenk,* which ought to contain so much that is positive, has not put us one step further forward in the question of the determination of sex. This theory, as was briefly and truly remarked by a critic, is *perhaps the weakest link in the chain of problems, that have appeared for centuries, in connection with the question before us.*

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[1]) Strassmann: Monatsbericht für Geburtshilfe und Gynäkologie. Vol. VIII. Pt. 1. July 1898.

Climate and Seasons.

It may be readily admitted, that the climate and the seasons exertise no small, nay sometimes even a distinct and decisive influence on the number of births generally, for we see, that animals from warm latitudes are mostly sterile with us, while our animals on the other hand, for example rabbits, fowls etc. produce in the tropics almost twice as many progeny. But how the climate can have a determining influence on the sex of a child, is not apparent to me, and probably is not intelligible to others either. Nevertheless some examples in support of the influence of climate, seasons, moon, and weather shall be cited here in order to show, the extraordinary circumstances some people will have recourse to in order to establish any sort of theory.

Thus *Girou* [1]) states; «When men from the South marry women from the North, they have more girls than boys, if no other influence is at work. Men from the North, who marry women out of the South, have more boys than girls.

According to *Breslau* [2]) the number of male births decreased and that of female births increases during the warm months, so that the warm seasons have a greater influence towards the production of females.

Lioy [3]) says that if a son is born at full moon, and a

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[1]) Girou: De la génération. Paris, 1838. Les hommes du midi, qui ont épousé des femmes du nord, ont eu plus de filles qui de garçons, lorsque aucune autre circonstance n'a dû influer sur le sexe des enfants; et les hommes du nord, qui ont épousé des femmes du midi, ont eu plus de garçons que de filles.

[2]) Janke o. c. p. 101.

[3]) Lioy, Sulla legge della produzione del sessi. Milan 1875, p. 14. Quando una donna dà alle luce un bambino in piena luna, o una bambina in nova luna.

daughter at new moon, it may be counted on with certainty, that the sex of the next born child is not changed. This rule may apply in every case to the whole course of the particular phase of the moon. *Berthon* [1]) generalised this observation which Lioy made in this way, that it is only the influence of the moon, that concerns the origin of the sexes, and that just as its phases are continually and regularly changing so in the very same way males and females are born on the earth in turns in ever constant proportions as the out come of a general law.

This theory, however beautiful it may sound, deserves to be placed in the same category, as the following one propounded by *Pliny* [2]), which, I admit, has reference only to Spanish sheep: «When the northwind belows (ar the time of copulation) males are conceived; when the southwind blows, females.

The Passion for propagation.

It cannot be denied, that at every act of coitus there is a certain emotion or passion in greater or less degree, which will exercise a certain influence on the transmission of certain peculiarities, such as character, faculties etc., whether in a positive or negative sense is of no importance here. But how this passion is to have a determining influence on the sex of the child, I cannot understand.

Even the old Hebrew physicians attached some importance to a certain passion during coitus, for we find in the *Talmud* [3]) this passage: «If the seed of the wife comes

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[1]) Janke o. c. p. 60.

[2]) Pliny, Historia naturalis VIII, 72. Aquilonis flatu mares concipi dicunt, austri feminas.

[3]) Wünsche, Der babylonische Talmud. Leipzig. 1889. Tract. Niddah. Chap. 19. p. 185.

first, then a male child is born [1]), but if the seed of the husband comes first, then a female child, i. e. if the wife is more fired with passion than the husband during coitus, a boy will be conceived, while if the opposite be the case a girl will be born. Raba said: «Whoever will beget boys must have intercourse with his wife twice in immediate succession.

Such a statement, as that which the Talmud makes, could not possibly remain unutilised, but must at once be used to advance a theory, according to which men of a nervous disposition and slender build, and women also sensitive, and particularly thin and lank, are wont, to have strong sexual passion; and accordingly such individuals have the greatest prospect of producing the sex opposite to then own in their offspring, so long as the passion of their consort is not so strong. Of course where a very strong passion is developed in a woman, during coitus after long abstinence, and she shows this by her active movements similar to those of her husband, then the birth of a boy from the subsequent conception is to be expected.

In the first place I must observe, that nothing can be found in this passage about the *passion for propagation*, for the sake of which indeed it is quoted, at the most we can only speak of a *passion for sexual intercourse*, and I have already expressed my opinion of it.

As regards the passion for propagation, which is continually spoken about in every possible way under the various theories, I understand by that the desire to have children, a desire, which may rise into a passion.

I have found a real, sincere passion for propagation. taken in the proper sense, only in married people, who

[1]) Leviticus. XII. 2. If a woman have conceived seed and born a male child.

have no children, but alas! it never lead to pregnancy, not to speak of the formation of a particular sex. In all other families, that are blessed with children, this passion appears as I can assert with confidence, either not at all or only very seldom, indeed I can prove, that with the third, or certainly with the fourth confinement all passion for propagation disappears!

It is true, I have often heard women, that have had two or three children in close succession, express the wish that they would be happy, if they had a dozen such, but in reply I can express my conviction, that such talk must be taken as mere boasting or else certainly as almost an excuse for their frequent pregnancies. I have often enough found these same women very unhappy, when they became pregnant for the fourth or perhaps the fifth time. Of course, no one but the husband and the family doctor knows the unhappiness, which such pregnant women feel; even their nearest relations are not aware of it, for people even boast in the presence of their relations, how they are blessed with children. As a matter of fact in most cases pregnancy does not occur after the birth of the third or fourth child. That this happens naturally I am inclined to doubt very much.

In those cases, where the women either from considerations of health or on religious grounds feel, that they cannot resort to any of those expedients, which prevent pregnancy. I have seen boys as well as girls born in spite of their disinclination to bear children. In this connection I might mention only one case from my own practice. It is the case of a lady, very happily married and liwing in the best circumstances, who was very fond of children and whose desire to have very many children, I was obliged to consider as a sincere one, since besides her own children she sought to take many more strange ones into her

house. After the lapse of a year from the birth of her third child, a boy, this lady was in spite of her *passion for propagation* confined again with a girl and not with a boy. Yet the dread of further pregnancy set in even in her case, as she herself confessed to me. But since she is one of the few women, who think it a sin to prevent pregnancy it happened, that up till now she has given birth to three more children, and all three were boys in spite of the absence of all passion for propagation. This case could indeed be very well turned to advantage by the supporters of the theory of Transmission of sex from the same sex.

The will.

The *will* may be associated with the passion for propagation with more or less reason, and indeed *Avicenna* [1]) put forward the statement, that the determination of the sex depends on the imaginative faculty of the more intellectual gifted father, and that the child grows always like that parent, whose image. was imagined by concentrating the thoughts upon it during coitus.

Supported by this statement *Renard* [2]) conceived the possibility of producing the sexes not from physical, but only from psychical causes. «The *will* of the parents and more especially that of the mother, can influence the polarity of the future child, and thereby produce the sex desired. The wife, who deeply loves her husband, and in the first months of her pregnancy vividly imagines his features in his absence, will not only give birth to a son, but will also see in him the exact likeness of his father.

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[1]) Avicenna. Canon med. Bd. I. Chap. 98. Natus similis illi, cujus imago intentu cogitatione tempore congressus fuit repraesentata.

[2]) Renard. Die Erzeugung des Geschlechts nach Willkür. Elberfeld 1819.

If you parents wish to have a daughter, then every time before the sexual act unite with each other in the firm resolution, to procreate a female child this time, and keep fast to your resolution until the mother gives sufficient evidence of pregnancy. You must also converse with each other upon this matter twice every day and rejoice in anticipation over it, while you intensely cherish the thought, that the fulfilment of your wish is certain and that it will afford you much joy. The mother especially must be strongly imbued with this thought and firmly resolved to give birth to a girl. No doubts may shake this fixed resolve. Understand only how to will, and you shall achieve»!

Now a days we would look upon this rule as *a kind of Suggestion or Auto-suggestion*. If this kind of suggestion had any effect in a few cases, how much peace and matrimonial happiness might be produced! **But alas! it is not true, that the power of imagination, or the firm resolution of a pregnant woman accomplishes anything at all in this respect.**

That the concentrated will, and the imaginative power in pregnant women can have an effect an certain external peculiarities, for instance upon the child, no one will deny, *but that neither Suggestion nor Auto-suggestion has any power to produce a particular sex, every body will admit, who knows families, in which for example only girls are born.*

Among families that are in the higher ranks of culture, the birth of several daugthers in succession, strongly, stirs up the desire, to have at last also a son, indeed it might be said, that in these families the desire for a boy arises very often and very earnestly. But when in spite of this a girl is again born, which alas! is often the case, then pregnancy does not occur again, 5—6 daughters are enough and yet the conjugal relations remains all the same quite as happy as from the beginning.

The question however has another importance in those families which in spite of culture and a high social position cannot free themselves from certain prejudices or in those, in which certain weighty interests are involved. In these families, as I have often observed, the birth of a girl as the first child produces a certain amount of disappointment. If the second child is also a girl, one can read the distressing feeling of a real misfortune on the faces of the parents, but more especially of the mother, and with every subsequent birth of a girl, there sets in a perfect estrangement between the parents, as I have observed in several cases.

Every one, who like myself, has had the opportunity of being family-doctor in such families for many years, will agree with me, when I assert, that in them not only the husband but much more so the wife, has no more longing desire, than to have a son and that too immediately after the birth of the first girl, and that this desire pervades their whole life and being, and especially that of the wife may be easily imagined, when the circumstances of the family are better known. If therefore one was ever to expect, that the imaginative faculty or the concentrated will had an influence on the determination of sex, then this influence must surely manifest itself in these last mentioned cases. But since I have never been able to discern any such influence in my practice, I deny it any value what soever.

Venette [1]) speaks very much to the point in that work of his, to which we have often referred, when he says:

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[1]) Venette: o. c., p. 296. L'imagination de la femme, quelque sort elle soit ne peut encore produire cet effet. Car combieu y a-t-il de femmes qui n'ont pas que des filles et qui ne peuvent avoir des garçons bien que leur imagination soit incessement embarassée et comme farciée de l'idée de ces derniers.

«The imaginative power of a woman, however strong it may be, cannot exercise this influence. How many women there are, who give birth to girls only, but never to boys, although their imagination is incessantly taken up with, thoughts of the latter»!

Out of the great host of hypotheses and theories which have been based for the most part on statistical results, and are supposed to explain the difference of sex, I have given only a small selection and it will be seen, that at all times the greatest trouble has been taken to establish, what are the conditions for the production of a particular sex. *While some observes would make the production of boys, for example, as solely dependent on the strength of the father, and some again would refer it to that of the mother, other investigators seek to solve the question of the determination of sex simply from conjugal intercourse, on fixed days before or after menstruation. Others again advise to keep in mind a set diet, observation of the phases of the moon and the direction of the wind, or the passion for propagation, or the firm resolve to produce a particular sex.*

All these theories furnish us, as I think, I have proved, *with* **nothing positive.** I have showed, that among the adherents of one and the same theory, some declare, that by following a procedure prescribed by them male children for example are born, while others positively asserts, that by these means female children must be produced.

It is not only, when taken singly, but when taken in conjunction with others, that theories can have any significance for the determination of sex and the negative value of these theories becomes evident, when one reflects, that the great majority of them cannot be applied to practical life that is really, what concerns us the most.

Düsing[1]) rightly says: However undeniably, interesting the statistical data present themselves through the principles, which are adduced from them, yet obviously they are not fitted to elucidate the physiological processes, which are at the bottom of these principles. However valuable they must remain for the theories, they can bring in no practical gain for application to every day life.

Nathusius[2]) also expresses his opinion on this point, that a certain regulation has been recognised in respect of the numerical ratio of the sexes in man, yet it has absolutely no significance because in every day life nobody can count upon having a certain percentage of sons and a certain percentage of daughters in his family, although on the whole a certain regulation undoubtedly exists here. A great part, of what has been written on Hereditary Transmission in particular, *has however no more value, that that of a collection of anectodes.*

II. The anatomical-physiological Causes of the difference of sex.

Before I enter upon the question of the origin of sex from the anatomical-physiological point of view, I do not think, it is out of place, to say a few words in advance on the origin of human beings from the ovum; of course opinions on this subject were bound to vary according to the stand point of science at the time. As long as the human ovum remained unknown (although its existence

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[1]) Düsing: o. c. p. 962.

[2]) Hathusius: Vorträge über Viehzucht und Rassenkenntniss. Berlin, 1872, p. 114.

was for a very long time surmised) [1]) it was firmly believed, that the wife had no share in the formation of the embryo, but yet her monthly discharge was necessary for this, partly by serving in the development, partly in the nourishment of the foetus, while it was the husband alone, who discharged the fertilising humour, which according to *Aristotle* [2]) acted not only as matter, but also as cause. According to this notion therefore the wife, or rather the uterus, was nothing more than the natural field, in which to sow the seed, for she has nothing to do wich procreation, her whole work consisting solely in further developing the male seed. When now *Leeuwenhoek* and his disciple *Hamm* made the discovery that the semen is not a homogeneous fluid, but is an «ocean of small, living, very active animals», and indeed many would even see the fully developed individual in the human spermatozoon, then the wife sank from her position, which was even then not a high one, several steps lower still. Although there were plenty of scientists, who denied all existence of spermatozoa, there were at the same time others, who advanced a theory according to which these lively animalcules were the tiny creatures, which represented the individual in their children. By this theory the power of reproduction was taken away from the wife and wholly ascribed to the husband. It was only on the discovery of the human ovum [3]),

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[1]) Empedocles, Anaximander, Epicurus, and Hippocrates indeed had inferred from the reproduction of birds, amphibians, and fishes by eggs a similar origin in the same of man.

[2]) Aristotle: Politik und Fragment der Oekonomik Schlosser. Bd. VII. Sect. 16, p. 97.

[3]) The real discoverer of the humanum ovum is v. Baer. De ovi mammalium et hominis. Leipzig 1827; although Prevost and Dumas (Annales de Sciences national. 1824) are to be regarded as the first; who obserwnd the human ovum, but did not recognise it.

that the wife took her proper position, although this could never yet be called an enviable one.

While the wife had formerly been looked upon as a kind of incubator, she was now treated as a mere egg-laying machine. *Schenk* in his theory takes up exactly the opposite position. According to him, the seminal fluid has only the function of giving the impulse to the ovum, to pass through all the changes necessary for the formation of a new individual, for the determination of sex the seminal fluid has further no influence at all. It was only by degrees, that the conviction forced its way, *that in the production of a new individual it is neither the husband alone, nor the wife alone that is the active agent, but that both together have the same great importance and significance.*

Once this position was happily attained, a position which up to the present time can be regarded as the only right one, and will be with difficulty shaken, people had at last to ask themselves the question, *when and where is the sex of the child determined?*

Since it was impossible to assume that the individual pre-exists in miniature as homunculus in either ovum or spermatozoon, there remain only the following possibilities: *the factor that determines the sex must exercise itself either at the time of impregnation, or later on in the uterus.* Although there were a large number of scientists who embraced the formed view, there was an even greater number of those who were of opinion, that for reasons, which have not yet been explained the sex of the Embryo is first determined in the uterus in the first months of pregnancy, since the child at the commencement of its embryonic life is of neither sex, that it is only in the 7-th week that the generative organs develope, that the difference of the sex proceeds from the 3-rd month on, and

it is only at the end of the fourth month, that the sex is distinctly pronounced.

According to *Waldeyer* the ovum is not entirely without sexual peculiarities, yet the ova are neither male nor female, for even the foetus at the beginning of its development is hermaphrodite.

In spite of the weighty authority of *Joh. Müller* we must regard this view as an entirely false one, and we can only attribute it to the inadequacy of our means of investigation, that it is not possible to recognise the sex of the foetus even at the earliest stage of its development. But here we have made a distinct step forwards trough the recent brilliant researches of *Nagel* [1]). So far as these go, it is possible at a very early period to tell from the anatomical structure of the genital glands whether one is dealing with a male or a female. He says: «The development of the genital glands in the two sexes is from a very early stage such a different one, *that we are not entitled, to assume a perfect identity in the development of these glands in both sexes*». According to Nagel it is not necessary to wait till the embryo is some 10 cm. long; even in embryoes 18—22 mm. long (therefore distinctly earlier than is described by other writers, as Köliker, v. Michalowitsch, Jonasek) one can recognise a distinct albuginea consisting of embryonic connective tissue, which separates the columns of cells, the future seminal tubules (with the spermatic cells, lying in them here and there) completely from the superficial epithelium which at this time is composed of regular cubical cells (p. 329)». Just as the testicle, the ovary reveals itself in its earliest phase as a ridge of germ-epithelium. which however is distingui-

[1]) Nagel: Ueber die Entwickelung des Urogenitalsystem's des Menschen. Bonn, 1889. Separatabdruck aus dem Archiv für microscopische Anatomie, p. 313.

shed from the corresponding protuberance in the male by the fact, that a much larger number of the germ-epithelium cells is turned into primordial ova *(Ureier)*, and that these cells *never at any stage in their development take on such a tube-like arrangement as is in the first phase of the testicle; in the first phase of the ovary one can see nothing at all that has any resemblance to the so called Valentin-Pflüger Tubes*». p. 330.

When *Tiedemann* [1]) and *O. Hertwig* [2]) take the process of development in both sexes to be the same up to the beginning of the 4-th month, then that is only a macroscopical criterion. *By microscopical examination it is now known that in the very first phases primordial spermatic cells and primordial ova are distinguishable.*

According to Nagel one might find a reliable sign of a male individual in the presence of a urethral orifice at the extremity of the glands, if one could exclude with certainty the possibility of similar formation at any stage in the development of the female. In a whole series of well preserved *female embryoes* up to the size of 4 cm. (taken according to the condition of the internal genital organs) he found the glans smooth and without a depression in front. *and in no female embryo was he ever able to prove with certainty a structure here, that reminds one of the orifice of the urethra.* Accordingly he finally comes to the conclusion *that in embryoes 25—30 mm. long and upwards one may take the presence of a urethral orifice on macroscopical examination as conclusive evidence of a male, so that (much earlier than is generally supposed) one finds in the external genitals signs for the distinction of the sex*». From this fact it may be taken as

[1]) Tiedemann: Anatomie der kopflosen Missgeburten. 1813.

[2]) Hertwig, O.: Lehrbuch der Entwickelungsgeschichte. II Auflage. Jena. 1888.

extremely probable, *that it is not during pregnancy that a determination of the sexes takes place but that the embryoes are of distinct sex from the very beginning*, for it is difficult to imagine, that the same causes are continually in operation during pregnancy in a woman, that gives birth to boys alone or to girls alone, and that another cause shall not even for once come into action which cause were it only but once, would produce another sex. If any one still wished to believe that the sex of the child is evolved only during the course of the pregnancy, then all influence on the determination of the sex would have to be denied the father, and it could not be explained, *how women, who by their husbands gave birth only to boys, have by an other man girls, or how widows, who by their first husband had only girls, gave birth also to boys with their second.* This fact, which was known even among the ancients [1]) forces us to the conclusion, that *the causes which determine the sex cannot work only during pregnancy, but that the determination of the sex of the foetus must be referred to the act of impregnation, i. e. to the period when the spermatozoon penetrates the ovum.* I hope, however to be able, to prove in the course of this treatise *that a pre-existence of the sex must be ascribed both to ovum and spermatozoon.*

The proposition made by *Anaxagoras* and *Hippocrates* may be taken as the starting-point of all the theories that rest on an anatomical-physiological basis; it was *that the male foetus lies more in the right side, the female more in the left* [1]). But after the ovaries had been discovered, this proposition might have been reformulated, or if *Hippo-*

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[1]) Hippocrates: Pleraeque enim mulieres suis viris feminas peperrere, quae cum aliis congressae, ex iis filios susceperunt. Et viri illi ipsi quibus mulieres feminas peperrere, cum aliis mulieribus congressi masculum prolem genuerunt; et quibus masculus foetus susciebatur, cum aliis mulieribus congressi, feminas genuerunt.

crates had known of the existence of the ovaries he would have made the proposition as follows: *The male foetus comes out of the right ovary, the female more out of the left.* This re-casting of the original aphorism is at all too bold, if we at the same time add the second proposition of Hippocrates: *Let it be observed which testicle is raised most* (during coitus): *if it is the right—a male child is to be expected, if the left, a female*[2]). By these words therefore *Hippocrates* maintains that *the right testicle contains male germs, and the left only female*, or to put it more cautiously, that *the seminal fluid of the right testicle can impregnate only male germs, and that of the left testicle—only female.*

There is no doubt whatever that these two propositions are derived from a large series of observations and much experience, but it cannot be denied that perhaps they have their real foundation entirely in the fact, that *the right side being the stronger must contain the male germs, and the left being the weaker side the female*, for *Hippocrates* says: *The greatest strength lies in the right breast, the right eye, and also in the internal organs*[3]). The Jews and Romans also considered the right side the stronger and hotter, and designated it the one, from which male children are derived.

Indeed for a long time the fact that the right side was really the stronger was denied, but through indubitable anatomical proofs this can no longer be disputed. The right

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[1]) Hippocrates: Aphoris. Sect. V. 48. Foetus mares quidem in dextris, femina vero in sinistris majis.

[2]) Hippocrates: De morbis epidem. VI. Chap. 4: Videndum, uter testis extra prominet. Quod si dexter, mas, si vero sinister femina portenditur.

[3]) Hippocrates: Epidem. Bk. II. Sect. 4. Plurimum habent dignitatis et praestantiae mamma et oculus dexter, eodemque rectitudo in inferioribus partibus.

upper extremity, for example, is 0.5 to 0,75 cm. longer than the left, the right clavicle is 1 cm. longer, and the development of the muscles in the upper extremities is very rarely the same on both sides. It is the not more frequent exercise of the right arm, but rather an original inequality in the musculature of both upper extremities in *favour* of the right that gives the right side sometimes a very marked advantage over the left.

We use the right arm more than the left, because it is the stronger, it does not become stronger because it is the more used. The total musculature of the right side stands to that of the left as 1 : 0,9527. (In the head it is as 1 : 0,992, in the lower extremities as 1 : 0,936, and in the upper 1 : 0,929).

It may be assumed as extremely probable that the ovaries and testicles are also of unequal size on the two sides (in favour of the right), for we know that the right spermatic artery usually rises higher up in the abdominal aorta, than the left, and the right spermatic vein with a larger opening flows directly into Vena Cava, while the left spermatic vein opens with a smaller lumen into the renal. As a matter of fact the above assumption is borne out by the results of *Hegar* [1]): for he has measured the lenght, breadth, and thickness of the ovaries on both sides during childhood, puberty, and in adults and found:

	Right ovary.			Left ovary.		
	length.	breadth.	thickness (in mm.).	length.	breadth.	thickness (in mm.).
Childhood	26·7	9	4·4	24	8·4	—
Puberty .	29·6	15	10	25	14	9·3
Adults . .	36·5	18	13·7.	35	16·7	11·3

[1]) Hegar: o. c., p. 951.

Whether *Hippocrates* wrote his above-mentioned aphorisms on the foundation of these anatomical facts or of a large number of observations is here of little consequence: the important thing for us is, that he describes a method for the production of boys or girls: «*The right testicle is to be bound as firmly as one can bear, if a female child is desired, and the left testicle, if a male child is to be produced*[1]). The first indication that the theory which Hippocrates propounded was turned into practice is found in Pliny's Natural History (Bk. III. Sect. 72) [2]), where he speaks of spanish sheep and makes the remark: *If the right testicle is tightly bound females are born, if the left then males*».

It was 800 years after Hippocrates before the proposal was brought forward by *Aëtius* [3]) to apply the second aphorism of Hippocrates to human beings. The passage in question runs thus: If the husband (before coitus) ties a white string round his right thigh and then has intercourse with his wife, he shall, it is said, beget a boy, while if he ties a coloured thread round his left thigh he shall beget a girl. The advice to bind the respective limbs can have only been given, I think, in order perhaps, to allow the testicle to rise more easily, but the different colours of the threads could have been of no importance, not even to Aëtius himself.

After this, 1400 years passed by without anything more being heard about the origin of the sexes from the anatomical-physiological standpoint, when *Couteau* again took up

[1]) Hippocrates: De superfoetatio. Dexter autem testis quod maxime ferri poterit, obligandus, sinister vero si maris is procreatio expetitur.

[2]) Pliny: Dextro teste praeligato, feminas generat, laevo mares.

[3]) Aëtius: Tetrabibl. Bk. IV. Chap. 32: Si vir, dextro pede fascia candida vincto, cum muliebre coeat, marem, ut ferunt generabit. Si vero sinistrum pedem colorata fascia ligabit, femellam.

the matter on the ground of the already mentioned difference in the right and left spermatic arteries and veins. and besides brought attention to the fact. that the vesicula seminalis of one side is larger than that of the other. and the ducts which issue from them keep quite separate from each other throughout their entire lenght; moreover each ejaculatory duct has its own separate orifice through which the seminal fluid is discharged into the urethra without the slightest intermixture. From this anatomical fact he concludes that the one testicle serves for the formation of males, the other for females, and that the same holds good in the case of the ovaries [1]). According to him one needs only to excise the respective testicle or ovary, that is intended for the opposite sex in order to produce children of the sex desired [2]). *But he does not mention for which sex each testicle and ovary is intended.* He is further of opinion that the wife possesses the power of directing the semen of the husband to either ovary just as she wishes. She requires only to keep leaning continually towards one particular side during the time when she is being impregnated, and the seminal fluid by its own weight is always made to sink into the fallopian tube, which opens out into the ovary as the wife has desired. But this advice has no scientific foundation. for the uterus is not a free cavity, in which a fluid (the semen) can be shaken to and pro.

Finally he draws attention to the fact which as we shall see later on is of the greatest importance. He says: *Yet as long as the ovary (of the wife) that is intended for a parti-*

[1]) Couteau: L'art de faire des garçons. Montpellier 1760, p. 179. L'un testicle serve à faire des mâles, l'autre des femelles, et il est ainsi dans les ovaires.

[2]) Couteau: o. c. Il n'y aurait donc qu'à se faire enlever le testicle ou l'ovaire destiné pour le sexe opposé, pour avoir des enfants à son gré. Note: Since he also speaks of the ovaries we can translate „enlever" only by „remove, excise" and not, as Janke thinks by „elevate".

cular sex is not moistened with the seminal fluid (of the husband) that corresponds to the same sex, the wife does not conceive. She becomes as a matter of fact pregnant only in the one particular case where this ovary is impregnated with the seminal fluid from the particular vesicula seminalis of the husband which corresponds to it. This statement I can only corraborate in its entirety.

If it is desired to bring this method of *Couteau* into practice, then it is only applicable for horses, cattle, sheep etc., for no woman, not to speak of a man, will ever entertain the idea of being castrated on one side, for the purpose of producing a child of a particular sex.

Although more than 2000 years had passed since the hypothesis of *Anaxagoras* and the aphorisms of *Hippocrates*, yet all investigators who worked on the subject of the origin of the sexes in man, moved always on purely theoretical ground and it never occurred to any one to test the propositions of *Hippocrates* by experiments on animals. It was neither a physician nor a scientist, but a lay man. *Henke*, the much «disdained» and «abused» sexton of Hildesheim, who sought to solve this interesting question by experiments on animals. Since the work of Johann Christoph Henke is difficult to obtain, and is to be regarded as the only one, which treats of such experiments in the most exhaustive manner, I take the liberty, to describe the researches of *Henke*, so far as it is necessary, at somewhat greater length [1]).

1. His first experiment consisted in his bringing together in August 1765 a sow in heat and a boar, *from which only the right testicle had been excised.* In the month of December the sow had a litter of 8 sow pigs. On March

[1]) Henke, J. C.: Völlig entdecktes Geheimnis der Natur sowohl in der Erzeugung des Menschen als auch in der willkürlichen Wahl des Geschlechts des Kindes. Braunschweig, 1786.

1766 the same sow came in heat, and Henke at once brought the same boar to her; and in July she brought forth a litter of 11 live pigs all sows.

2. Henke took 3 dogs (males) of different variety and had *the right testicle of each removed* on the 2-nd September 1766. The first one (a mongrel) covered a bitch on the 8-th Jannuary 1767 and on 12-th March a litter of 8 bitch puppies was born. The second dog (a Pomeranian) had connection with a bitch on 20-th Jannuary which brought forth seven bitch puppies on the 24-th March. The third (a pointer) covered a bitch on 23-rd February and on 28-th April she brought forth four bitch puppies.

He kept these bitches as well as the castrated dogs still shut up, in order to repeat the experiment a second time. On 6-th August the Pomeranian bitch came in heat, and on 13-th the mongrel; on the 7-th October the former brought forth 5 bitch puppies and on the 13-th seven bitch puppies were born of the latter. The pointer bitch had not come in heat again.

3. Simultaneously with this experiment he had the right testicle of 3 he-rabbits excised and during the summer he got nearly every 5—6 weeks only young she-rabbits.

4. On the 22-nd September he had *the left testicle* of a Pomeranian and a mongrel dog excised. On the 11-th December the mongrel had connection with a bitch and on 17-th February she brought forth a litter of sex male puppies. The Pomeranian covered a bitch on the 7-th Jannuary 1768 and on 12-th March eight male puppies were born.

5. In the same way he made experiments with he-rabbits also in the summer of 1768 *by having their left testicle removed*, and there were always born only young he-rabbits, as often as the she-rabbits were pregnant. He then turned his attention to the castration of female animals.

6. On the 17-th August 1768 he had *the right fallopian tube and ovary of* various bitches removed when they came in heat. he brought to them the dogs, *whose right testicle had been excised.* The one mongrel bitch had copulation on 16-th December, and on 18-th Februar 1769 brought forth five young bitch puppies. The second bitch was covered on 11-th Jannuary 1769, and on 14-th March had seven young ones all female.

7. When the same bitch was again in heat, he brought a normal dog to her. She had connection on 1-st August 1769. and in October produced only females.

8. He brought *the other bitch with the excised right ovary and tube to a dog whose left testicle was removed.* Although they had connection *together, no impregnation followed* and therefore no litter.

When *Henke* after frequent repetition of these experiments always obtained the same results, he came to the fallowing conclusions:

a) *Each testicle secretes its own special semen.*

b) *Each ovary contains its own kind of ova* viz. *the right ovary male ova, and the left female.*

c) *The semen from the right testicle is only capable of impregnating the ova of the right ovary, and the semen from the left testicle only the ova of the left ovary.*

Supported by the fact which *Couteau*[1]) had already established that the ejaculatory ducts are in their whole lenght separated from each other, and that each has it own special opening, through which it discharges the seminal fluid into the urethra without any mixture with the fluid from the other duct, *Henke* comes to the conclusion.

d) that *in every coitus performed in the* usual *manner the seminal fluid is always discharged from only*

[1]) L'art de faire des garçons. Par M. docteur en médecine. Montpellier, 1760, p. 179.

one *seminal vesicle, namely the one on the side, on which the testicle prepared beforehand rises up before the critical moment of the ejection of the semen,* i. e. *the semen comes from the right vesicula seminalis, if the right testicle is raised up, and from the left vesicle, if the left testicle is raised.*

Since *Henke's* conclusions on the whole agree with my results, I will later discuss the objections with which it was sought to throw redicule on the tenets of Henke, and will at this point only remark that immediately after the appearance, nay even at the mere announcement, of his small work the great majority of scientists turned against *Henke*, since they were unwilling to admit that a layman should have made a discovery in Medicine, which hitherto the greatest scholars of ancient and modern times had sought in vain and even held impossible, to find out. They regarded not only the work itself as ridiculous and absurd, but even its author as fit for a lunatic asylum. Here is a recurrence of what so often happens in the history of discoveries. *Certain erroneous notions continue for centuries to be handed down from generation to generation as incontrovertible truths*, which admit of neither doubt nor opposition, *when some intrusive person comes in and alleges he has discovered the true theory and then it requires a very long time before the correct comprehension gains ground after a long hard fight against the spirit of the age and the dogged persistence, with which the prevailing opinion keeps its hold*, while its discoverer is rewarded with ridicule, scorn, malediction and even worse.

So far as I have occupied myself with the literature on this subject, I have never found that it occurred even to one of the great scholars to test the experiments of *Henke*, a course which would have been simpler and more natural than forming hypotheses and theories the untenableness

of which people were from the very beginning convinced of. It was of course beneath the dignity of the anatomists and physiologists to follow in the path, on which a layman was bold enough to take the lead. According to Franck [1]), *Bischoff* is said to have carried out these experiments at first with successful, but later with unsuccessful result, but nowhere else could I find a description of this, and *Wagner* speaks of an oral communication, that *Bischoff* made to him on this matter.

That is the sum total of my knowledge of the authorities on this question

Soon after the appearance of this work (german edition) I was pleased to see, that *A. Gönner* [2]), repeated the experiments of *Henke* (Nos. 6 and 8) in the physiological institute in Basel. Although the results which he obtained on rabbits do not entirely agree with those of *Henke* and myself, yet I owe him a deep debt of gratitude, and all the more because he undertook the work. in spite of the fact that my theory seemed to him from the very first highly improbable. From his experiments he did not find it confirmed. that the right ovary and testicle contain *male* germs and the left ovary and testicle *female* germs. I admit *Gönner* is perfectly right when he asserts, that a single faultless observation which proves the opposite, is enough to overthrow my theory. Granting such an observation, I cannot however say that I agree with the conclusions, which *Gönner* draws from his experiments. He cannot put forward the statement, that «because rabbits castrated on one side bring forth young ones of both sexes. then my theory is false», all he can say is that my theory does not hold

[1]) Franck: Handbuch der tierärztlichen Geburtshilfe. Berlin. 1876.

[2]) Gönner: Ueber den Einfluss einseitiger Castration auf die Entstehung des Geschlechtes der Frucht. Zeitschrift für Gebürtshilfe und Gynäkologie. Vol. XXIV. Part. 2.

good with rabbits. And yet it does not at all follow, *that this result obtained from rabbits must also be applicable to human beings*, for it is very questionable *whether the experiments made on litter-bearing animals and the results obtained therefrom must at once hold good for woman* also, who belongs to the class of uniparous animals. If therefore any one desire to test the truth of my theory, that each ovary and each testicle contains one kind of germ by experiments on animals, he will have to choose for this purpose not litter bearing (as rabbits, dogs, pigs) but uniparous animals (horses, cattle, sheep). I have already in another place pointed out, **that everything that holds good among the lower animals is not at all necessarily applicable to human beings as well.**

Nevertheless the comparison of the true corpora lutea in primiparae with the sex of the progeny is absolutely conclusive and raised above all dispute and doubt, and I consider this method, which *Gessner* and *Gönner* have suggested of such significance and importance that experiments on animals seem thereby in my opinion to be almost superfluous. Here too *Gessner* and *Gönner* come to conclusion that my theory is wrong, since according to their results true corpora lutea corresponded to male births as often as to female, and true corpora lutea were met with in the left ovary although males were also born. To this I must first of all remark, that I put forward the statement *that the right ovary contains particularly ova for the male sex and the left ovary ova for the female*, in order that it may not be understood that I have said that the right ovary must contain *exclusively* male ova and the left ovary *exclusively female*.

Gönner's material consists of 12 primiparae and he found 3 females true corp. lut. twice on left side, and once on right; 9 males, true corp. lut. 3 times on left side

and 6 times on right. If anyone draws from these figures the conclusion that my theory is false, because in female births true corpora lutea are to be found in the right ovary as well as in the left and because in male births the same can also be said, then I must be also allowed to conclude from the very same figures, that *the left ovary shows twice* as many female ova as male (2 : 1) and that twice as many males as females come from the right ovary (6 : 3). But it is at once seen that these figures are far too small, to warrant certain conclusions from them, and that it requires a much larger number of observations in order to come to a decided judgment.

According to *Janke* tis true, a contemporary of Henke carried out a long series of experiments on animals 6 years after the publication of Henke's work *exactly* according to his directions, without obtaining one result that supported Henke's theory. The large (sic) series of experiments which this unknown author brought out in the monograph. «Einzig mögliche Zeugung. Berlin 1792—consisted in his taking 3 dogs one day and excising the left testicle of one of them, and the right of the other two. The dog whose left testicle was removed died after the operation: the other two were kept for use each being shut up alone and let loose to a bitch which was specially intended for him. And this is what is called a large series of experiments conducted exactly after Henke! Indeed this unknown author passed the most correct judgment on his own work by his never once venturing to put his name to it, and although the so called large series of tests alone was sufficient to permit of a decisive opinion being passed on the experiments Henke made, yet I take the liberty to quote a few sentences from his book word for word just to show the character and medical knowledge of this person. On p. 38 he says: «A man must have an

astonishing idea of the semen and its constituents and shows plainly that he knows nothing about it, when he asserts that it can stay for several days in the uterus, and can rise into the fallopian tubes in the same condition and consistence». On p. 42 and 43 he writes: «The seminal fluid does not pass into the uterus, does not come into the tubes, and cannot reach the ovaries but remains in the vagina. The vagina is however the place where the development of the individual begins. The folds of the vagina serve for the purpose of keeping the semen in the vagina longer, in order that the absorbent vessels may take it up and carry it into the blood». «The blood of the mother, as soon as it is impregnated with semen comes into a state of effervescence etc.". «That a woman has no seminal fluid and gives nothing towards the production of a new individual is clear». «She is only the receptacle etc.».

It is hardly credible, that the opinion of such a person should suffice to keep men from returning to experiments on animals again, that people passed over *Henke* either in silence, or contempt, they were done with Henke, and free scope was given to ideas hypotheses and theories, in which age, nutrition, and such like nonsense played a leading part.

It was only in the year 1807 that a work by a French physician, *Millot*, appeared, a work, which it seems is to be found only in a German translation and confirms the correctness of the Ovarian Theory on anatomical-pathological grounds [1]).

He declares quite openly that he proposes no new theory but has brought together the best in the opinion scattered here and there in the various theories of repro-

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[1]) Millot: o. c., p. 251.

duction, and relying on the observations of *Venette*[1]) he has come to the conviction that

Firstly, the right ovary always produces male embryoes, while the left always female (Millot, p. 187). He came to this conclusion from the condition of two autopsies: in one woman, *who had had seven boys, he found the left ovary in a scirrhous condition,* while in the other, *who had given birth to four girls, the right ovary was quite smooth, without any spots or projecting vesicles,* and much firmer and smaller than the left.

Secondly: If however through some digression in nature from the normal conditions the ovary which contains the male ova, lies on the left side of the uterus, it is certain, that after impregnation of the left ovary in such a case a boy will be produced, while by impregnating the ovary on the right side a girl will be born. *This change of position of the ovaries is extremely rare and must be regarded as a remarkable variation from the usual course of nature* (Millot, p. 251).

Thirdly: If the ovary (ovum) does not come in contact with the seminal fluid of the testicle, which corresponds to it, then the wife remains sterile, while she becomes impregnated when the semen of the right testicle reaches the right ovary, and in corresponding manner for the left side (Millot, p. 211). And yet he declares, that the husband has no part in the determination of the sex, that the testicles both secrete similar fluid, that the ovaries alone possess the power of forming the generative organs in parti-

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[1]) Venette: o. c., p. 248. The passage to which Millot refers runs as follows: „Je connais quelques femmes, qui ont toujours accoutumé de se coucher sur le côté droit, lorsqu'elles dorment avec leurs maris, et c'est aussi dans cette posture, qu'elles sont caressées et qu'elles conçoivent presque toujours des garcons.—Que les femmes qui se couchent ordinairement du côté droit ne font presque jamais des filles.

cular, and that this last function is specially performed and completed by each ovary (Millot, p. 265).

For the production of a particular sex the wife according to *Millot* must hold her pelvis moderately inclined towards the side, on which the ovary it is desired to impregnate lies.

He quotes several examples with good result: e. g. *two women who always lay on the right side of their husbands gave birth to six girls in succession, but after they changed their usual places in bed, they gave birth only to boys. Another woman who had had only boys changed her usual place in bed and then give birth to girls and when she resumed her former place in bed, then boys were born to her again.* Besides these examples here quoted he describes several other cases of the same kind, in which the change of the position in bed was followed by the result desired.

Next to Millot we must here mention *Kol*[1]) who is also of opinion, that the sex is determined beforehand in the ovaries. According to him *the left side determines the formation of the female sex, the right that of the male.*

According to *Steinbach*[2]) the whole function of the husband during coitus consists in his stimulating the reproductive elements lying dormant in the female generative organs and in calling them into activity. It is only after the act of coitus, that the wife assumes the first place in that she unites, as it were, the seminal fluid with the ovum, and assimilates it and thereafter cares for, and nourishes this ovum thus transformed and also assimilates it.

The Embryo however owes its formation to neither of

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[1]) Kol, o. c., p. 35. Latus enim sinistrum muliebrem, dextrum virilem indolem praecipue petere videtur.

[2]) Steinbach: Quae parentum vis sit in prolis procreationem. Dissertatio. Monaco. 1823.

its parents, father nor mother, but evolves itself as the result of its inherent power of formation, its vis plastica or nisus formationis, as it is usually called.

Finally his work proceeds to prove, *that the right testicle contains, just like the right ovary, germs for boys, and the left testicle like the left ovary those for girls.* But a method, by which a particular sex might be produced, is not described.

Roth [1]), who was a strong opponent of the theory of Transmission of sex from the opposite sex, was in recent times a warm supporter of Millot's theory, according to which each lateral half of the female generative system plays a prominent part in the production of the future sex of children viz. *one ovary supplies the ova for male children, the other those for female.* But while Millot propounds no theory, of his own for the production of a particular sex and supports his arguments solely on his own observations and on the experiments of Venette, Roth gives an explanation which has much merit.

According to Roth the mechanical pressing-in and irritation of the one side of the external genitals, increased by the touching and pulling of the pubic hairs is first felt and then by the pudic nerve through the hypogastric plexus transmitted to the corresponding side of the genital canal and uterus, and the fallopian tube and ovary of the same side. But if each normal ovary represents either the male or the female sex, then the corresponding parts of the external genitals through the specific irritation and increased activity of the pudic nerve and its connection with the hypogastric plexus appear to be the organs, by which the corresponding sex is determined. *In order therefore to have boys and girls as desired, he must lie on the opposite*

[1]) Roth, G.: Ueber die Bestimmung des Geschlechtes. Deutche Med. Zeitung. 1884. 26.

side of his wife, to that on which one was accustomed. He confirms this theory by the following four cases taken from his practice:

Case I. «A Mr M. had had hitherto only girls (6) by his wife; he changed his position in bed and lay on the opposite side of his wife, and from that time forth received only boys» (3).

Case II. «A Mr W. had had only daughters (4), born to him by his wife. In consequence of changing his position in bed, he received only sons afterwards» (4).

Case III. «Mr L. had only daughters (4) by his marriage, and after following the advice, to change his position, he received 3 sons».

Case IV. «Mr R. had only girls (4); but following the above advice, he received 1 son».

A very severe blow was dealt this ovary-and-testicle theory by the Frenchman *de Bay* [1]) when he advanced the following conclusions on the ground of anatomical-physiological facts: 1. *The right and left ovaries of a woman contain ova, which are exactly identical with one another*; 2. *So too the seminal secretion of the right and left vesiculae seminales of a man has exactly the same composition and possesses exactly the same physical, chemical, and vital properties;* 3. *Corresponding with this, the ova in both ovaries possess absolutely no difference whatever in sex, nay rather they show exactly the same natural constitution;* 4. *In the same way the spermatozoa in the seminal fluid contain independently no sexual element;* 5. The ovum however is impregnated by contact with a spermatozoon, and without the latter impregnation is not at all possible. He accordingly comes to the conclusion, that the sex depends on the quality of the ovum and of the

[1]) Janke: o. c. p. 80.

seminal fluid which impregnates it, and is always definitely fixed during the act of impregnation itself. The correctness and importance of these conclusions, considered from an anatomical-physiological point of view stand above all doubt and yet I maintain, that they are still no proof against the theory, that each ovary and testicle contains its own particular germs. In vindication of my contention I cannot do better, than quote an example from the physiology of nerves. As is well known, nobody has hitherto succeeded in discovering the slightest difference in structure or chemical composition between a sensory and a motor nerve, and therefore we would have logically to deny any difference in function. In spite of all apparent similarity in their anatomical structure and chemical reactions, what a difference in function exists between a sensory and a motor nerve! Indeed, I will go so far as to assert, that in the various regions and tracts of the human brain certain differences in texture or composition will one day be found. In other words I am of opinion, that what holds good with nerves, may also be applicable to other tissues. Who can be so sure, that under other circumstances no one will ever succeed in finding out a difference? I will only call to mind, that in every branch of science, and more especially in medicine, *much was at first taken for so much myth and madness, either from inadequate observation or from very prejudice, that was afterwards found to be perfectly true.* I recall the fact, (just to keep within the subject) how after the discovery of the ovaries nobody would believe in the capability of the tubes to apply themselves against the ovaries, and yet this has been proved beyond all doubt. In the same way *the penetration of the spermatozoon into the ovum* was for a long time repudiated by the greatest authorities in Physiology; and it was only after the discoverer of this action of the spermatozoa *(Barry)* was joined

by others such as *Wilson* and *Newport*, that this fact was admitted by one of its greatest opponents *(Bischoff)* to be correct. *How many great discoveries have been at first rejected on purely theoretical grounds*, and only *after a long hard struggle, often after the death of the discoverer, the truth came out victorious!* The names of these men, who could often be regarded as real martyrs, will for ever shine in the annals of science, while their scoffers and persecutors have for the most part fortunately fallen into oblivion!

A fact that has been so often proved by practical experience, such as the Ovary Theory offers, cannot be attacked on purely theoretical grounds and I am firmly convinced, that here too the time will some day come, when there will be no more doubt, that each testicle contains particular spermatozoa and each ovary particular ova. But that the right reproductive gland is **always** set apart for males and the left **always** for females, I would not positively assert.

What shall we say, however, when this same *de Bay* departs from the purely anatomical-physiological point of view, leaves those conclusions of his which are mainly theoretical but yet logical, and forms for himself a new theory of the determination of sex, according to which the larger or smaller amount of nitrogen, as it is contained in the chemical composition of both ovum and seminal fluid, is of the greatest importance? If for example the seminal fluid contains a greater amount of nitrogen, in comparison to the ovum, a male is produced; while, if there is more nitrogen in the impregnated ovum, a female is then developed.

This hypothesis possesses, in my opinion, neither a scientific nor a practical value and must be placed on the same level as that of *Ackermann*. According to his theory an ovum must be discharged at coitus, in which the hydrogen

is in excess over the oxygen, in order to produce a female embryo.

These two theories require no serious discussion, neither does that propounded by *Cohen* [1]). According to his theory cerebrospinal force (?) proceeds from the husband: if it prevails during impregnation, then a male embryo is produced, but if the sympathetic of the ovum (?!) prevails, then a female is formed.

To the already enumerated followers of the ovary theory I must add a name from more recent times viz. that of *Stockton-Hough* [2]) who expresses this opinion on the matter, that the ova from the right ovary are provided they are impregnated, more adapted, to develop into males, while the ova from the left develop into females.

B. Schulze [3]), *Schröder* [4]) and *Ahlfeld* [5]) I reckon also as supporters of the ovary theory to a certain degree. yet I must guard myself most distinctly from the charge of *Stratz*, that I asserted. that these authors regarded the right ovary as the place of preparation for male ova, and the left for female, and there can be no question of a misrepresentation as Stratz supposes, since I have quoted the opinions of the above-named writers verbatim.

B. Schulze: «Probably the conditions for the development of one or the other sex are already present in the ovary.

Schröder admits that there is much to be said for the theory, that the sex is already determined in the non-impregnated ovum.

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[1]) Cohen: Das Gesetz der Befruchtung. Nördlingen. 1875, p. 35.

[2]) Stockton-Hough: An enquiry concerning the relative influence of sex. Americ. Journ. of Obst. Vol. XVII, 1884.

[3]) B. Schulze: Ueber anormale Duplicität der Axenorgane. Archiv für pathol. Anatomie. Vol. VII, p. 479.

[4]) Schröder: Archiv für Gynäkologie. Vol. IX, p. 255.

[5]) Ahlfeld: Ibid. p. 256.

Ahlfeld: The probability, that the ovum already possesses a particular sex before its impregnation, is greater than the one, that it is only with impregnation that a sex is given to it. There are namely male and female ova in the ovary. This much is quite certain that it is not the case that the sex is not determined till the first period of development.

I consider these expressions of opinion just quoted as of such importance, that should my theory turn out false, I would most distinctly follow B. Schulze in his opinion, that each ovary contains ova of different sex.

Now as regards my own observations, I have already stated in the preface, that I came in a purely empirical way to the conviction, that the production of a particular sex, to use Janke's own words, is a matter, that is not so very abstruse, and its scientific explanation depends on hypotheses that are not so far-fetched, as at first glance appears.

I had made the observation that whenever people, that had had several children of the same sex in succession, travelled or went to the country or into a new house, and another pregnancy supervened, the sex of the children was very often changed, and I found that this was always the case when the parents changed their position in bed. *If the husband lay on the left side of his wife, then a girl was born, if he lay to the right of his wife then a boy.* It happened so often, that from the position, which the parents occupied to one another in bed, I could in most cases predict the birth of a son or of a daughter without more ado. Up to the present time I have at my disposal altogether 1000 cases comprising somewhat more than 300 families, and out of this large number I find only 21 cases in 6 families, where the results anticipated were not realised.

In seeking for an explanation of this remarkable phenomenon I proceeded, as I remarked at the outset, from the aphorisms of Hippocrates, according to which the male embryo lies in the right side of the uterus, the female embryo in the left. In order to test the correctness of this tenet, it only required a large list, giving the position of children a short time before delivery, and if *Hippocrates* is right then it must turn out, that if the foetus in the vertical position has its back to the left. a female child is born, but if its back is turned to the right, then a male: in a horizontal position of the child (it matters not whether its back lies in front or behind) the position of the head will determine in this way, that when it lies on the right a girl is born, if on the left, then a boy is to be expected. In order to have a large mass of material. I applied to the director of the Moscow Lying-in Hospital requesting him, to put at my disposal the material, which he had, yet my request and wish were never fulfilled. Fortunately we are not solely dependent on such a statistical record, which moreover cannot be perfectly accurate especially when it is known, how often an assistant or even the nurse enters in the reports any position by chance, which may not correspond with actual fact. But even in the case where there was no mistake. one would have to be prepared from the very start for a large number of exceptions, for one knows, that on its exit from the tube the impregnated ovum does not always lodge itself in the first best position in the uterus, but not infrequently wanders from the right side into the left fallopian tube and vice versa from the left ovary into the right tube.

A sure indication, that the foetus really lies as *Anaxagoras* and *Hippocrates* assert, which is the same as saying that the right ovary contains male ova and the left ovary female, may be found in the results of gynaecolo-

gical operations and more especially the cases of tubal pregnancy. To be sure, the cases in which the sex of the child is definitely given are extraordinarily few, at least in proportion to the frequency of tubal pregnancy: but for reasons easily understood, it is in the vast majority of cases not possible, to note the sex of the foetus, although on the other hand, I will not conceal the fact, that gynaecologists regularly omit to mention the sex. That I do the gynaecologists no injustice in this respect, is proved by *Neugebauer's* collection of 150 cases of symphysiotomy, in which the sex is mentioned altogether only 28 times, although that could have been so easily done in every case. I have not made use of the results of ovariotomies for my theory, because they have not nearly so much significance for the question under discussion, as the cases of extrauterine pregnancy, although in the latter cases too an error may come in through the migration of the ovum, and I shall refer to ovariotomies later on.

The cases, which I have found in the literature and which support the Ovary Theory, are: —

1. *Beaucamp*, Zeitschrift für Gynäkologie, 1884. Vol. X, p. 256. Right tubal pregnancy—Boy.
2. *Maschka*, Archiv für Gynäkologie, 1885. Vol. IX, p. 814. Right tubal pregnancy—Boy.
3. *Weinbaum*, Centralblatt für Gynäkologie, 1885, p. 128 Left tubal pregnancy—Girl.
4. *Galle*, Ibidem, 1885, p. 598.
   In the left horn of a uterus bicornis—Girl.
5. 6. 7. *Strauch*, Petersburger Medic. Wochenschrift, 1892, p. 331. Case II.
   Twice, right tubal pregnancy—Boys.
   Once, left—Girl.
   (Two of these cases communicated personally).

8. *Schmidt*, O.
Right tubal pregnancy—Boy.
(Communicated personally: specimen showed).

9. 10. *v. Ott*, Beiträge zur Kenntniss der ectopischen Schwangerschaft. Leipzig, 1895. Cases I and V.
Case I. Left tubal pregnancy—Girl.
Case V. Right sided pregnancy in rudimentary horn of uterus—Boy.

11. *Schatz*, Mitteilungen aus der Leipziger Klinik. Archiv für Gynäkologie. Vol. I, p. 289. Case IV.
Pregnancy of left horn—Girl.

12. *Spiegelberg*, Ibidem, p. 403.
Right tubal pregnancy—Boy.

13. *Fränkel*, Archiv für Gynäkologie. Vol. XIII, p. 249. Case I.
Right tubal pregnancy—Boy.

14. *Matlakowsky*, Archiv für Gynäkologie. Vol. XXXVIII, p. 367. Case I.
Right tubal pregnancy—Boy.

Further. the following examples also furnish proof, that the right ovary contains male ova and the left ovary female.

15. *Strauch, M.*, Centralblatt für Gynäkologie. 1887. № 3.
Uterus didelphys cum vagina duplice. The child, a boy, lay in the right half of the uterus, while on the left side the vagina was narrow, and the portio vaginalis in a virgin condition.

16. *Smith*, A contribution of the determination of sex. American Journ. of Obst. April 1885. p. 413.

A woman had given birth to three boys in succession, but after the right ovary was removed, she gave birth to a girl.

17. *Sippel*, Situs der Früchte bei Zwillingsschwangerschaft, Zeitschrift für Geburtsch. u. Gynäk. Vol. X. Pt. 2, 1884, p. 322.

This most instructive case concerns a woman, a 5-para, who suddenly dies at the normal end of that gestation. At the post-mortem examination there is found in each ovary a corpus luteum, which warrants the conclusion for the development of the twins from different ova out of different ovaries, and for the presence of separate chorions, as was actually the case. The left child, which is of weaker development, lies huddled together and is a girl, while the child on the right side is a boy.

18. *Millot*, o. c.. p. 187.

A woman, whose left ovary was found on p. m. examination to be in a state of scirrhous degeneration, had given birth to seven children who were all boys.

19. *Millot*, Ibidem.

A woman, whose right ovary was quite smooth and showed no scars or projecting vesicles, had given birth to four children, and each child was a girl.

20. *Dr. Eckstein*. Teplitz (Communication by letter).

Right tubal pregnancy—Boy.

The few exceptions which go against this theory, I will mention later on (in the sixth objection).

As regards experiments on animals, I had from the very first conducted them only to see, whether each ovary really contains particular ova, in this way that ova for male individuals are formed in the right ovary, ova for female in the left.

For this purpose I had the right ovaries of two she-rabbits and the left ovaries of other two excised and after

their recovery from the operation let them run about free, i. e. not shut up with he-rabbits; 38 days after the operation two of these rabbits brought forth young, one of those with retained left ovary four she-rabbits. and one of those with retained right ovary five he-rabbits. On the 39-th day the second rabbit, with retained right ovary, had four he-rabbits, and on the 40 th day the second of the two, with retained left ovary, six she-rabbits. Without isolating these castrated rabbits in any way, which I considered very important, in order that they might be covered as far as possible by different he-rabbits, the same result happened on the 41-st and 42-nd day after the first brood to this extent, that the rabbits with right ovary removed brought forth only she-rabbits (4 and 3) while those with the left ovary removed only he-rabbits (4 and 4).

Since these experiments showed, that the right ovary contains male ova and the left only female, then logically each testicle must also possess its own particular spermatozoa, *for there is absolutely no sexual peculiarity in a man, which has not a perfect analogue in a woman, and vice versa.*

I resolved therefore to castrate 2 dogs. since the heat in rabbits ceases in October and does not begin again till April. A veterinary surgeon E. K. A. decided to extirpate the right testicle of one dog and the left testicle of the other, but our project was not carried out, because Mr A. could not guarantee, that the bitches to be brought to them (which must have both ovaries intact) could be kept strictly isolated, and that each bitch would have connection exclusively with the castrated dog intended for her. There was accordingly nothing left for me but to proceed to Dorpat (Jurgew) in order to get Professor Guttmann of the Veterinary College to carry out the experiments

which I desired. This also in reality pleased me better than if I had had the experiments done in Moscow, because when they were carried out by an impartial person and a man of repute there could be no doubt about their correctness. The Experiments which I desired and proposed were intended to consist of the following:—

First Series of Experiments: Two bitches were to be taken and the right ovary of the one and the left of the other removed: they should not be isolated, on the contrary should be allowed every opportunity to have connection with several dogs.

Second Series: Two dogs were to be taken and the one castrated on the right side, and the other on the left; they should then be allowed to go with bitches which must have however both ovaries intact, and the greatest care must be here taken, that the bitches, which have been covered by one of these dogs, have connection with this dog alone and with no other. The strict watch and isolation of the bitches with the one dog must be continued until there is absolute certainty of their impregnation.

Third Series: At the next period of heat the same bitches (not the castrated ones) were, to be so paired with the castrated dogs, that the bitch, which was the first time allowed to go with the dog whose left testicle was removed, had this time connection with the other dog, and in the same way, the other non-castrated bitch, which was the first time isolated with the dog whose right testicle was excised, was this time locked up with the other.

Fourth Series: This was to be done merely as a control experiment If each testicle is only capable of impregnating the respective ova of the corresponding ovary, in other words, if the semen of the right testicle can only impregnate the ova of the right ovary, then impregnation cannot take place, if a dog with its right testicle excised is

brought to a bitch, whose left ovary has been removed. In the same way a dog castrated on the left side and a bitch castrated on the right, were to be brought together and if this Ovary and Testicle theory is correct, then pregnancy could not ensue in this case either.

Although the experiments, as has already been remarked, were for reasons unknown to me not carried out, and if I nevertheless venture to bring my views of the determination of sex before the public, I do it, because I confess quite openly that I would have desisted from experiments with animals altogether, had I at that time (October 1894) been acquainted with the literature on the subject; it was only afterwards, that I came to learn from this literature the experiments which *Henke*, *Couteau*, *Venette*, and *Millot* had made, and these so perfectly correspond with the results, which I obtained in a purely empirical way (and I have not merely a few cases, they number indeed over 1000), that I considered it was not right to wait any longer, and that too all the more, because the results of tubal pregnancies speak for the correctness of the Ovary Theory.

Objections to the Ovary-Testicle Theory.

In discussing *Henke's* experiments, I made the remark, that I would mention several objections, which might be made against the Ovary-Testicle Theory, in order to show, that this theory is justifiable on all sides, and as far as our present knowledge goes, is the only one that solves the question of the origin of sex in the most satisfactory manner.

Objection I. If the theory, according to which one testicle contains particular spermatozoa for impregnating male

ova and the other particular spermatozoa for female ova, is correct. *how is it then possible, that men with one testicle beget children of both sexes, and that some races in South Africa Has the se Hottentots, the natives of the Friendly Islands etc. have not long ago died out*, seeing, that all the males there are castrated on one side, the former on the right, and the latter on the left!

Before I take up the reply to this objection, I must here call to mind, that there are various kinds of men with one testicle; they are either congenitally so, or are castrated on one side. In the former class we must further distinguish those, who have really only one testicle, from those persons in whom the second testicle has remained in the abdominal cavity and has not descended into the scrotum.

The absence of one testicle through arrest of development is a thing of the greatest rarity and was described by *Follin* and *Gosslin* [1]: the vas deferens ended in the scrotum as a blind sack; the vesicula seminalis of this side was present but small and contained no spermatozoa. Simultaneous absence of the testicle, vas deferens, and vesicula seminalis of one side has been reported by *Blaudin* [2]. These cases, unique in their way, cannot be taken into consideration here, more especially when it is not mentioned, whether these men were married and had had children. Accordingly, when we speak of men with one testicle who are born so, we can think of those only in whom the other testicle has not descended through the abdominal ring. (Cryptorchismus). As regards this condition, we know that it sometimes happens that one or even both testicles remain during the whole life of the person in

[1]) Follin and Gosslin: Archives générales de médec. 1851. Vol. 26, p. 260.

[2]) Blaudin: Anatomie topograph., p. 443.

the abdominal cavity, or that one testicle sinks into its permanent position only a considerable time after birth: the testicles that remain in the abdominal cavity usually lie near the inguinal canal, and in rare cases before the lower border of the kidney, the position of their original development. The testicle which remains in the abdomen may atrophy although this will seldom occur (*Hyrtl*) [1]).

Cryptorchids can beget both male and female children, if they beget children at all, supposing that the testicle remaining in the abdomen is not atrophied. In all my 37 years' practice I have never seen a single case of permanent Cryptorchismus and therefore the remark I have just made cannot be confirmed by examples.

I will here quote fully the letter of a colleague in order to show. how easy it is to assume, that a person with one testicle can beget children of different sex, if a very thorough examination is not made, and further that the right testicle contains semen for boys and the left for girls, and lastly that the position. which married people occupy to one another in bed, is of importance for the determination of sex.

L... 6/VII, 189*.

Dear Sir,

Having come into possession of your monograph (German edition) on the Determination of Sex I take the liberty of communicating to you a case, which tends to confirm your views. *It concerns myself.* In consequence of a delayed Descensus testiculi dextri my right testicle, which did not leave the inguinal canal (into which even yet it sometimes slips) till my 16-th or 17-th year and only then with the help of a truss, is backward in its development: it is at most only a third as large as the left testicle. I am

[1]) Hyrtl: Topographische Anatomie.

now 38 years old and have 3 children, one son $6^1/_2$ years old, and two daughters $5^1/_2$ and $4^1/_4$ years old respectively. My son has now testicles so poorly developed, often hardly palpable and of about of the size of a pea that I cannot help thinking that the spermatozoa which impregnated the ovum at his conception have also come from the right testicle.

Highly gifted though he is mentally (especially musically) his development in respect of the innervation of his muscles alone gives rise to much anxiety. The child is big and apparently strong for his age, yet his musculature is altogether so weak that he requires watching and nursing such as is hardly necessary in an ordinary child of two years. His gait and the use of his hands and fingers extremely weak and awkward: undue mobility of joints as a result of deficient tone in the muscles. In using the flexor muscles, the antagonistic extensors are quite relaxed and therefore in every movement cannot exercise inhibition. He falls nearly over every stone and has to be for the most part led by the hand. Writing in spite of $^1/_2$ year's training is out of the question; he will never learn that. His food must be cut into pieces so small, that he hardly requires to chew, for which act he is scarcely capable on account of his weakness in respect of the deficient innervation of his masticators. Otherwise he swallows almost everything unchewed. My daughters on the other hand are perfectly normally developed both mentally and physically. With regard to the position during coitus, I have also reason to acknowledge your theory as correct.

I remain, with best wishes,

Yours sincerely,

(signed)—

Dr. R. rightly assumes, that the weakly boy can only have been derived from the poorly developed small testicle,

in which the formation of spermatozoa could be only imperfect, while the two healthy girls could be only the result of impregnation with semen from the left (normal and healthy) testicle.

But the question is quite different *in those persons, who have had one testicle excised*, and of such castrated men I must maintain, that *they will only beget children of one sex*. To be sure, I have often heard and read that men with one testicle have begotten several children, yet it is not mentioned whether these children were both male and female, but the chief point is wanting viz. whether such men were always cryptorchids or one of their testicles had been excised. While I admit, that cryptorchids may beget children of both sexes, I must distinctly deny any such possibility for castrated men. But if some observers communicate undoubted facts, that *they have seen children, both male and female, born of men with one testicle* (through castration), I take the liberty to ask this pertinent and perfectly legitimate question, whether these observers are able to give a certain guarantee *that some good friend has not perhaps helped in the matter*, a thing that will not so seldom occur in men, who possess both testicles.

Now as regards the practice, or more properly speaking the malpractice, of castration among individual races, one cannot be cautious enough in assuming the trustworthiness of certain scientists and writers. Thus the botanist, *Peter Kolben*, [1]) relates that the Hottentots make a priest excise the left testicle of their boys, and states that no woman would have intercourse with a man, that had not undergone this operation. Although *Kolben's* account gives one the

[1]) Peter Kolben: Beschreibung des Vorgebirges der Guten Hoffnung. Frankfurt, 1745, p. 147.

impression of being true, yet he has possibly confused circumcision with castration, for subsequent observers make no mention that the Hottentots practise castration *(Ploss* [1]*)*. To this we may reply, that this custom is at present not to be found at all, or at any rate very seldom, while it was in general vogue 100 years ago; but 30 years after *Kolben*, his account was contradicted by *Le Vaillant* [2]), who regards it as nothing more than fiction: he found among the Hottentots, whom he calls Cheyssiquis, the custom of circumcision. According to *Fritsch* [3]) Kolben has been simply imposed upon and deceived with regard to the removal of the testicle for that of the prepuce.

An account of much moment and one which speaks strongly against this theory is that given in recent times by *Otto Finsch* [4]). According to him, the natives of Ponape (Eastern Caroline Islands) excise the left testicle of boys, when 7—8 years old, because the young women think the men with one testicle more handsome and more to be desired. *Finsch* has corroboration of this from a «trustworthy» source. Yet how trustworthy this source is may be imagined, when one reads the article by Finsch in the original and not merely an abstract of the same. According to his own account *his authority is a white man, who was settled on the island*, a seaman (does he mean a sailor?), but during his short stay in the island of Ponape *he had not himself made enquiries as to this custom*, a fact which he specially emphasizes. But that there is little or no truth in all this must be inferred from *Kubary*, who does

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1) Ploss: Das Kind. Berlin, 1882. Vol. I, p. 340.

2) Le Vaillant: Reise nach dem Vorgebirge der guten Hoffnung, Berlin. 1784, p. 173.

3) Fritsch: Eingeborne Südafrika's, p. 333.

4) Finsch, Otto: Zeitschrift für Ethnologie, Jahrgang XXII. 1880, p. 316.

not say one syllable about this practice, although otherwise he was not too reserved in his reports. Captain *Wright* says that this custom is in vogue in Niutabutabu (one of the Friendly Islands) where almost every young man of twenty years *has only one testicle*. While other travellers, scientists etc. write, that the men have all the right or the left testicle extirpated, *Capt. Wright* says that the men have only one testicle. But that is quite different! This observation, which Wright made, can be regarded as the only right and true one in those countries where castration of the males is generally practised, else the races would have really died out long ago. Hence we may infer, that neither cryptorchismus nor castration *forms any* argument against the Testicle Theory.

Objection II: Even though it were admitted, that each testicle contains separate spermatozoa, *yet with every coitus male as well as female spermatozoa must pass into the uterus, since as a matter of fact the seminal fluid is discharged from both testicles and not from one.*

The anatomical structure of the vesiculae seminales speaks at once against the assumption of a simultaneous discharge of seminal fluid from both testicles, for these organs have each their own special duct as far as the urethra and do not open into one common duct. That the seminal fluid is discharged only from the testicle, that rises up during the act of coitus, I conclude from the following facts. 1. An acquaintance of mine was operated on in 188—in Billroth's Clinic for removal of the right testicle, and in spite of this two more daughters were born to him. When he came to me and complained about this, I advised him, since he had children enough with those he had, to lie in bed on the right side of his wife, and since that time this man's wife has never again been pregnant. I must also here remark, that the man is now a little over 50 years of age,

while his wife is only 42, is quite regular, feels in perfect health and shows no signs of the menopause coming on. 2. I have in my practice several cases *where in consequence of severe Orchitis with subsequent fixation of the spermatic duct the men begot only children of one sex, but whenever they changed their position in bed, pregnancy never occurred again.*

If therefore with every coitus the seminal fluid came from both testicles, and not exclusively from the one, which rises up during the act, then in the above-mentioned cases, where as in the castrated man only one testicle was present, and in the second only one testicle was normal and could discharge seminal fluid, *impregnation would have been bound to take place.* Since however the men take up a position, in which only the formerly diseased testicle was wont to act, and in consequence pregnancy did not ensue, then there is only the one conclusion to be drawn *viz. that the remaining healthy testicle did not take part in the discharge of semen.*

A case of the most instructive value and of great practical worth might be here related. It concerns a married couple, who had been already nine years married, but had no children. Having examined the husband and found considerable induration in his left epididymis, I advised him, seeing that he always lay to the left of his wife, henceforth to lie on her right side. The result of this was, that the wife gave birth to two boys. I confess quite willingly and openly, that a physiological explanation, why only one testicle discharges its fluid during coitus, caused me very much worry, for the observations, which I had made, were all I had at my disposal. When I was engaged on the article on Reproduction I was very pleased to read in *Landois*: [1]) «Both vesiculae seminales and ejaculatory

[1]) Landois: Lehrbuch der Physiologie des Menschen. Wien und Leipzig. 1889. Vol. II, p. 1000.

ducts *do not always discharge their contents into the urethra simultaneously.* Instead of «not always» I would put «almost never».

Any man may convince himself of the correctness of my assertion that during coitus only one testicle discharges seminal fluid, for with each complete erection only one testicle rises up to the abdominal ring, the right testicle, if the right leg is *raised* or right knee flexed in order to cross over, the left testicle if a similar movement is made with the left leg.

Objections III. If a man with only one normal testicle takes during sexual intercourse such a position, *that this healthy testicle cannot come into action, whence then comes the seminal fluid, that is ejected at the end of the act? It can surely only come from this testicle.*

The fluid, which is discharged during such a coitus is, I have convinced myself, *not seminal fluid at all, but simply a mixture of the secretions of the accessory sexual glands* (vesiculae seminales, prostate, and Cowper's glands), which correspond to the secretion, which a woman also often discharges at the end of the sexual act.

To those, who will not believe, that a secretion which is entirely without spermatozoa can be discharged during coitus, I will here remark, I have recorded amongst other cases in my practice three, in which the wives who were sterile had been treated by most of the gynaecologists in Moscow and the most famous men in other countries without success. When I became acquainted with these ladies and found them perfectly healthy I got their husbands to call on me. In one case a previous attack of Syphilis, in the other two Orchitis, was the cause of the coitus between man and wife (with copious emission) having no result, as the examination of the semen discharged a short time before showed the entire absence of spermatozoa. To

be perfectly sure I got the husband himself in one case to take the fluid, which was actually discharged during coitus, to Professor Klein (within half an hour of the act); *On microscopic examination of this fluid not a single spermatozoon could be found.*

The principal cause of the absence of spermatozoa (Aspermia) is to be found in Gonorrhoea, to which sterility is far more often due than to Syphilis, since the former produces such changes in the generative organs, male or female, that the secretion loses its normal character and it leads to the disappearance of the elements of reproduction.

For cases such as the above I cannot omit giving here a practical suggestion, which although it has nothing to do with the question of the determination of sex, may yet be mentioned.

Although the wife, who is sterile, is as in my three cases perfectly healthy, I nevertheless advise her to travel two or three months every year, if her means permit of it. In doing so, I have two aims, first, that she does not lose all faith in her doctor, and second, that by being separated from his wife for several months the husband may get the chance of recruiting himself by abstinence from sexual indulgence so far, that perhaps spermatozoa afterwards appear. But it is the attitude of the doctor towards the husband, that is of the greatest importance. He dare not on any account explain to the husband, that he would not be able to beget children for two reasons; firstly, the doctor cannot tell, whether spermatozoa will not in time return, for according to *Utzmann* [1]) Aspermia may be either *relative* or *absolute*, *permanent* or *temporary;* and secondly, nobody can vouch, that the wife might not forget herself and have relations with some other man. The mis-

[1]) Utzmann: Wiener Centralblatt für Gynäkologie, p. 600.

ery in a family, which may be caused by such an explanation from a doctor, is beyond calculation! The doctor must be not only a doctor, but also human, nay human above all things! But the greatest caution must be shown by the doctor before the wife too in the interest of the husband as well as of the family happiness. It is much better to throw the cause of the wife's sterility on herself, in her own presence, than to assure her for comfort's sake, that she is (or has been) quite healthy and that the husband alone is to blame, that they have no children.

Objection IV. If each testicle contained spermatozoa of a particular sex and if during coitus the seminal fluid were discharged from only one testicle, *how could the birth of twins of a different sex then be explained?*

This objection is really one of great importance, yet only an apparent one, and in order to refute it I must go into the question of plural pregnancies somewhat more closely. Although I have already spoken about the origin of twins in the section on Reproduction, I yet consider it necessary here to give some statistics for the purpose of showing, that the birth of twins of different sex is not so common as of twins of the same sex.

Generally speaking one estimates one twin birth in 70—80 single births, one triplet in 5000 single, and one quadruplet in 330000.

Thus *Veit* [1]) gives for Germany the following proportions out of 13,360,557 births:

1 Twin birth in . . .	89	single.
1 Triplet	7.910	»
1 Quadruplet	371.126	»

For France *Dubois* [2]) gives a collection of 484.350 births and finds:

[1]) Veit: Monatschrift für Geburtshilfe: Vol. XI, p. 127.
[2]) Dubois: Gaz. des Hôpitaux, 1843.

1 Twin birth in . . . . 78 single.
1 Triplet . . . . . 6,209 »
1 Quadruplet . . . . 121,082 »

For Russia, and especially for Moscow and St. Petersburg, the proportions are much more unfavourable, in as much as twins and triplets are much more often met with there than elsewhere. In 177,671 single births in Moscow and St. Petersburg there were 3,498 twins (i. e. 50 : 1), and here it is to be remarked, that there are years, in which twinbirths are much more common than in others: thus in 43 years eight years were recorded with twins in the ratio of 1 : 37—42; 16 years with ratio 1 : 43—48; 10 years, 1 : 49—50, and 9 years 1 : 60—96, i. e. over all an average ratio of 1 : 54. It turned out too, that married women give birth to twins distinctly, oftener than unmarried.

In *married* primiparae the ratio was 1 : 71 · 5
» *unmarried* » » » » 1 : 86 · 5
» *married* multiparae » » » 1 : 33 · 9
» *unmarried* » » » » 1 : 54 · 1

Of 144 twinbirths there were 50 times 2 boys, 42 times 2 girls, and 52 times a boy and a girl, and these figures correspond with the result obtained in other countries. Thus *Scanzoni* found among 124 twin births 92 with children of the same sex, and 32 with children of different sex. *Moser* [1]) found in 335,556 twin births only 36·21%, twins of different sex, for Saxony *Ploss* [2]) found only 32·37%, *Neefe* [3]) 36·4%, and *Meckel v. Hemsbach* [4]) among 141,715

[1]) Moser: Die Gesetze der Lebensdauer. 1839.
[2]) Ploss: Zur Zwillingstatistik.
[3]) Neefe: Zur Statistik der Mehrgeburten.
[4]) Meckel v. Hemsbach: Mueller's Archiv für Physiologie. 1850. p. 235

twinbirths 36·15%. *Späth* gives the proportion as 128 : 56, and *Elsässer* as 62 : 20.

From these figures it is seen, that twins of the same sex are twice as common as twins of different sex. This greater frequency of twins of the same sex as found by *Sharp* is quite extraordinary, for he observed in 765 births thirteen times twins and of these there were seven times 2 boys, five times 2 girls, and only once a boy and a girl.

A second point, which is of importance in our reply to the objection above made, is the relation of the twins to their chorion.

It is a well known fact, that twins of one sex have one chorion, but it has never yet been observed, that twins of different sex were found in a common chorion. It is true one does find it recorded, that twins of a different sex were found in one chorion, but reports of this kind are quite false, since according to *Ahlfeld* [1]) ill developed male genitals were taken for female, and *Olshausen's* words as to twins of different sex in one chorion are «absurd reports and as absurd theories».

If we keep in mind these two facts, viz. the much less frequent occurrence of twins of different sexes and the constant appearance of such twins in separate chorions, and if we add to this the fact, which, I think, I have proved, that each testicle contains particular spermatozoa, then we are forced to the conclusion: *that twins of different sex cannot be produced from a single impregnation, in other words, that these twins must be solely the result of superfecundation.*

Although Superfecundation is not altogether disputed, it

[1]) Ahlfeld: Die Ursachen der Geschlechtsdifferenzierung. Archiv für Gynäkologie. Vol. IX, p. 251.

is still considered by many to be a thing of the greatest rarity, because. as is known, the os uteri closes when pregnancy begins, and then seminal fluid cannot pass into the uterine cavity. Even in *Hippocrates* [1]) we find a remark, which refers to this: «Superfecundation occurs only in those women, in whom the os uteri is not closed, as is plainly proved by certain signs; but it closes after the second impregnation, the product of which is also born later».

But when we consider that *the seminal fluid requires as much as ten hours to reach the ovary* and the closure of the os uteri does not take place, until the impregnated ovum has begun its passage through the fallopian tube into the cavity of the uterus, *it is decidedly possible, that within the first 24 hours a second impregnation can take place* under certain circumstances, if coitus has occurred a second time or even several times much sooner, if not a very short time, after the first coitus. *These circumstances*, under which a second impregnation can occur, *depend on the emission of semen from different testicles*, i. e. if it comes from one testicle the first time, it comes from the other the second, *for which it only requires the accident or opportunity, that the second coitus is had in a different position from the first.*

Superfecundation is a phenomenon often observed in such animals as the horse, dog. and cat, and of this I will here mention only several examples, In 1809 a mare brought forth a mule and half an hour after a foal (Oken). Case 2: On 28-th March 1851 a mare was covered by an English stallion and on 5-th April by an Arabian stallion. On 28-th February 1852 she produced two foals, which resembled their

[1]) Hippocrates: De superfoetatione. Superfoetant autem mulieres, in quibus os uteri post primum conceptum non ita valde clauditur, quod evidentibus quibusdam signis constat. Clauditur vero, ubi superfoetatum, quod posterius in lucem emittitur.

sires [1]). Case 3 from *Brisson* [2]): He observed a mare, that had been already four times covered by the same stallion. and half an hour later the owner brought an ass to her for the last time and he also covered her; the mare threw a foal and a mule. Several examples of the same kind are found in works on Veterinary Obstetrics [3]). The same thing is seen in dogs and cats, in which several ova are discharged in one period of heat, and if such animals are covered by several males of different breed we see that they produce young of different kinds and mongrels.

A circumstance, that is highly instructive and affords strong proof of the correctness of the theory, *that during sexual intercourse the seminal fluid of only one testicle is discharged and that this semen can impregnate ova of only one sex*, may be found in the fact *that those animals, that produce several young in one litter, always bring forth young of one sex if they have been only once covered*, while their brood consists of different sexes, whenever the female has had connection with several males. While it is difficult in ordinary life to isolate litter-bearing animals such as dogs, cats, and swine in such a way, that during one period of heat they have no connection with other males, and accordingly we see them for the most part producing young of different sex, an observation made by *Ihering* is decidedly in favour of my contention.

Azara had already in the last century reported, that the Armadillo, Praopus hybridus, living in Paraguay and the Argentine Republic produces at every litter young of only one sex.

Ihering found this fact confirmed in two cases; in each

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[1]) Journal de méd. vétérin. 1852, p. 426.

[2]) Brisson: Canstats Jahrbücher, 1859, p. 6.

[3]) Frank: Handbuch der tierärztlichen Geburtshilfe. Berlin 1876, p. 120.

case he found eight foetus in the uterus in exactly the same stage of development, all the eight were of the same sex and each foetus had its own amnion, while they were all together in one chorion. *Ihering* comes finally to these conclusions: 1. Each foetus has its own chorion, and the sex of the twins is sometimes the same, sometimes different, and this is explained by the fact that each of the two children is derived from a particular ovary; and 2. both foetus possess only one chorion, and twins that have sprung from one and the same ovary are invariably of the same sex [1]).

We have no need to form conclusions by analogy from the lower animals to Man, for in the latter too superfecundation has been proved beyond doubt, since women gave birth to twins, *of whom the one was the child of a white man, the other that of a negro* [2]). *White* reports the case of a negress who had twins, the one child perfectly black with woolly hair, the other quite white, with long hair. There would indeed be greater opportunity to establish cases of superfecundation, if in the crossing between races, as experience proves, children did not sometimes resemble the father alone or the mother alone, so that even the white child of a white mother may be the legitimate offspring of a negro. *(Kussmaul* [3]), *Spiegelberg* [4]), *Walden* [5]), *Schröder* [6]). For reliable cases of superfecundation compare Bulletin de la société de Medécine 1821; Recherches anatom.-physiol. sur les cas d'uterus duplex *(Velpeau, Senzion)*. Unfortunately the sex

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[1]) Ihering: Zeitschrift für Physiologie, 1886, p. 443. Ueber Generationswechsel bei Säugetieren.

[2]) Landois: Lehrbuch der Physiologie. Wien u. Leipzig. 1889. p. 1002.

[3]) Kussmaul: Von dem Mangel und der Verkümmerung etc. Würzburg 1859, p. 271.

[4]) Spiegelberg: II Auflage, Lehrbuch der Geburtshilfe.

[5]) Walden: Centralblatt für Gynäkologie.

[6]) Schröder: Lehrbuch der Geburtshilfe. VII. Aufiage.

of the children has not been given here, although it would be of the very greatest importance for deciding the question, whether each ovary or testicle discharges its own particular germs.

Yet, I think, I am bound to assume, that the children in a case of superfecundation must be of a different sex, *otherwise I could not understand, how the semen of the second impregnation could pass through the same tube to the ovary, in which the seminal fluid of the first coitus had already accomplished its work!*

But in support of the view, that each testicle or ovary discharges its own particular germs and that in superfoetation the children are different in sex or, as I maintain, twins of different sex are the result of superfecundation, I can quote two cases from Millot and one case from my own practice. «A man went home with his wife from a very jovial party, at which they had supped with some friends, and immediately after they reached their house the wife received a warm proof of her husband's power. They then went to bed and after a short time coitus was repeated. A few days after the first signs of pregnancy set in, and the result shows the correctness of this supposition, *for «in due time she was delivered of two children of different sex»* [1]).

In another quite similar case [2]) a wife, 26 years old, gave birth to a second child seven days after the first. This delay however cannot be looked upon as a case of superfoetation, for a second impregnation occurring seven days after the first cannot be well assumed. And as a matter of fact the cause of the delayed birth of the second child proved to be the too firm texture of the amniotic sac, so

[1]) Millot: Becker, Die Erzeugungskunst. 1807, p. 151.

[2]) Collections des Mémoires de l'Academie de Sciences. Vol. VII, p. 670.

that the contractions of the uterus alone were unable to effect its rupture.

My own case is that of a woman, who besides other single births had already had twice twins, the first time two girls and the second time two boys. As regards the third twin birth with children of different sex, the husband remembered quite distinctly the night, when he and his wife came home from a wedding and he retired to bed before her. Half undressed she came to him to wish him good-night, when coitus took place, after which she undressed herself completely and lay down in her own bed. Shortly after coitus again took place and the result was a twin birth of children of different sex.

A fourth example, not belonging to my own practice, but communicated to me by a colleague, concerns a wealthy couple, who had been married many years; they had already had several children at single births and for a good finish were favoured with twins of different sex after they had had connection one night in different positions.

I feel warranted in saying that as regards superfecundation the circumstance may also in my opinion be indicative, that *twins of different sex are much rarer in the better classes, although among them too the husband and wife have connection more than once in 24 hours, especially in the first period or in the first years of their married life.* This, I presume, arises from the fact, that *in the upper classes the husband and wife always occupy a definite position to one another, because they have their own beds,* while in the lower classes repeated intercourse may take place within 24 hours and that too in different positions.

Twins of the same sex, on the other hand, are born with the same frequency among the rich and the poor alike, because it is a well known fact, that in many women

there exists a predisposition to twin pregnancies, and this predisposition depends on heredity viz. on the hereditary nature of the ovaries, a fact which makes no distinction between high and low, rich and poor. As an example, I will quote the case of *Goehlert*. In the Hanau family the occurrence of twins continued for a period of 270 years. Twins were born to *Philipp of Hanau* (1480), *Philipp of Hessen* married to the daughter of the former: *Adolf of Holstein* married to the twin-daughter of Philipp of Hessia; *Ludwig of Hessia* married to Philipp's great-granddaughter: *Karl Ludwig of Baden*, married to the great-granddaughter of Ludwig VI; *Max I of Bavaria* (1756) married to the twin-daughter of Karl Ludwig; further, *William IV of Hessia*, son of the above mentioned Philipp; *Ferdinand Albert of Brunswick* married to the great-granddaughter of William of Hessia; *John of Nassau*, whose mother was a daughter of William IV of Hessia; *Christian Ludwig of Waldeck*, married to the daughter of Philipp of Hanau; *Adolf III of Nassau*, married to the daughter of Philipp of Hanau, *Simon VII of Lippe* married to the great-granddaughter of Philipp of Nassau.

As regards triple pregnancies, I have already at the outset indicated the conditions under which triplets occur, and I will give here only a few statistics. According to *Veit* there were out of 1689 triplets 409 times 3 boys and 359 times 3 girls, while 501 times there were 2 boys and 1 girl and 420 times 2 girls and 1 boy. From these figures we see, that while among twins the difference in sex makes up about a third of all twin births, the births of children of the same sex among triplets are much rarer than those of children of different sex, and here the extraordinary fact comes to light, that a comparison of multiple pregnancies brings out the preponderance of male births (2749) to female (2502), a proportion which is much great-

er than in single births, viz. 110 : 100. For triple pregnancies too, I make the same assertion, as I made in the case of twin pregnancies, i. e. triplets of the same sex are derived from one impregnation, while in triplets which are different in sex it is to be assumed, that they are the result of superfecundation.

From all that has been said it follows, that the occurrence of twins different in sex affords no proof against the assumption *that each testicle and each ovary contains only its own particular germs and that during coitus seminal fluid is discharged from only one testicle.*

At this point I must make a practical observation. As long as pregnancy does not set in, *one should beware of having sexual intercourse in different positions* within a period of 3 days after each other, *because in the latter case superfecundation might take place and thereby twins would be produced by women*, in whom indeed there exists no tendency to twin pregnancy. *Still more does this advice refer to those women, in whom a predisposition to twin pregnancy is present, for the neglect of this warning in their case might lead to a triple pregnancy.*

Objection V. If each ovary discharged its own particular ova, then as *Hippocrates* says, every female foetus would have always to lie on the left side of the uterus, and every male on the right, since the impregnated ovum on its exit from the fallopian tube settles down at the nearest spot; but this is not always the case, and therefore the ovary theory is false.

To this we have to reply, that neither *Hippocrates* nor anybody else maintains that the female embryo always lies on the left side of the uterus and the male on the right. He says: «Foetus mares quidem in dextris, femina vero in sinistris majis», i. e. the male foetus lies *more* in the right side, while the female *more* in the left; it is

accordingly from the very first admitted, that this rule like most others has its exceptions. Yet for these exceptions a plausible explanation can be easily given, viz. this — It is a well known physiological fact, that the impregnated egg does not always fix on the first best position, but makes long migrations both external and internal. *Landois* [1]) says: Under exceptional circumstances the ovum discharged from the ruptured follicle of one ovary passes into the fallopian tube of the other side, as is proved by the occurrence of tubal pregnancy and pregnancy of an abnormal rudimentary horn of the uterus, in which case the true corpus luteum is found in the ovary of the other side. *(External migration—Kussmaul, Leopold).* In animals with a double uterus with two orifices the ova may also migrate through the os of the one into the other uterus up to its horn. *(Internal migration — Schaeffer* [2]). *Conrad* and *Langhans*, among others, have established 17 cases of migration of the ovum from the left ovary into the right tube and vice versa from the right ovary into the left tube. *If therefore the migration of an impregnated ovum from one ovary to the tube of the opposite side is a fact proved beyond doubt, it is then very possible, that an ovum can settle itself on the opposite side of the uterus itself.* Hence it follows, that the foetus will not always take up the position in the uterus that belongs to it from its sex, and to this circumstance we must ascribe the fact, that the doctrine of *Hippocrates* on the position of the child in relation to its sex, does not always apply: but how often this occurs, I cannot tell from want of statistics. Yet even although these exceptions were very numerous, one could only claim, that *Hippocrates'* aphorism does not hold good;

[1]) Landois, o. c. p. 1002.

[2]) Schäffer: Zeitschrift für Gynäk. u. Geb. Vol. XVII, p. 13.

on the other hand even the many exceptions do not by any means entitle us to assume that the theory, that each ovary discharges its own particular ova, is consequently wrong.

Objection VI. If the right ovary contains only ova for male individuals, and the left only ova for female, *then how are we to explain those cases in operative Gynaecology that prove the very opposite?*

I have taken the greatest possible pains [1]), to look for such exceptional cases, but besides the case from *Schatz* which I have already mentioned I have succeeded in finding only three: these are from

1. *Benicke* [2]). Case of woman with double uterus and vagina. Pregnancy of the left half—Boy.
2. *Spiegelberg* [3]). Right tube—Girl.
3. *Matlakowsky* [4]). Left tube—Boy.

Now while in these three cases we might assume the possibility of a migration having taken place, the case which *Schatz* reports precludes all possible doubts; it is decidedly opposed to the Ovary Theory, and it was just on that account that I chose this case for the explanation of the exception.

As we have already quoted in the discussion on the theory of Transmission of sex from the opposite sex, the case of Schatz refers to a girl 20 years of age, in whom in consequence of an ovarian cyst not only the left ovary,

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[1]) Again I call attention to the fact that I have chosen only cases of tubal pregnancy for reasons that I have already given in p. 122; and it is just for these reasons that I consider the case cited by Stratz as irrelevant, since it is one of ovariotomy.

[2]) Benicke: Zeitschrift für Geburtshilfe und Gynäkologie. Vol. I, p. 366.

[3]) Spiegelberg: Archiv für Gynäkologie. Vol. XIII, p. 73.

[4]) Matlakowsky: Archiv für Geb. u. Gynäk. Vol. 38, p. 367.

which was found completely diseased, was removed together with a portion of its tube, but also the whole of the right ovary with the exception of a border of at most 2 mm. breadth, which was left behind; the right fallopian tube was also left intact. Four years after the operation she was married and gave birth to a girl and not to a boy, as we should expect according to the Ovary Theory[1]).

In order to explain this exception I must have recourse to an analogy from anatomy. It is a well known fact that people are usually *right-handed*, and when we meet with a left-handed person, we look upon him as an exception. that in no way nullifies the general rule. Among 182 persons *Malgaigne* found five left-handed, i. e. almost 3%. It was at first believed, that a person becomes left handed in this way, that in order to keep one's own right hand free, one carries the child on the left arm, whereby it is chiefly its left hand that becomes free and in time it accustoms itself to take hold of everything and do everything with the left hand. But it afterwards turned out that the cause of the greater development of the right upper extremity is normally to be sought in the origin of the great arteries from the aortic arch. The right subclavian artery arises nearer the heart than the left. The systole of the heart will exercise a greater influence upon it than upon the left.

The right subclavian will, like all its branches, necessarily have a greater capacity than the left, since the blood in the former circulates at a higher pressure. But an abnormal condition in the origin of these vessels from the aortic arch occurs, in which the right subclavian arises behind the left in the proportion of about 2 : 100. When this is the case there exists in regard to the pressure

[1]) Schatz: Gynäkolog. Centralblatt. Vol. IX, 1885, p. 353.

with which the blood circulates in both arteries, exactly the opposite state of things to what must normally occur. *The left upper extremity will become the stronger*, and will accordingly in practice maintain the advantage over the right.

A somewhat similar relation is also found in the vessels of the ovaries and testicles. The spermatic arteries arise laterally from the anterior aspect of the aorta close under the renal arteries; they arise usually at an unequal height, the right as much as two fingers'breadth above the left, so that the arteries of the right ovary and the right testicle have a greater capacity than those on the left side, since the blood in them circulates at higher pressure; the nutrition of these organs will also be stronger, and perhaps it is to this that we have to attribute the fact, that *the right ovary and testicle appear more suited to produce male germs*, while *those on the left side being less highly nourished* seem to be *fitted rather for the formation of female germs*. As the result of this anatomical relation of the bloodvessels, the ovaries also show a difference in size: the right, as was already mentioned in pag. 102 according to the investigations of *Hegar*, is longer, broader, and thicker than the left.

But we find a difference not only in the arteries, but also in the veins to the advantage of the right side, the difference in the latter being greater and more striking. The spermatic veins arise on both sides from the pampiniform plexus, which in the male begins around the testicle and epididymis and runs alongthe spermatic cord, and in the female is formed by the junction of the ovarian and uterine veins at the upper part of the broad ligament; the veins rise up in great numbers alongside the arteries of the same name and gradually unite into a single vessel, *which on the right side opens into the inferior vena cava, and on the left runs into the left renal vein.*

In those cases, therefore, *wheret he origin of the arteries* and the opening of the veins are abnormal, *the function of the organs supplied by them will also necessarily be changed. in other words, the right ovary or right testicle, being supplied with less blood and therefore weaker,* will not be able to form *male* germs as they would under normal circumstances do, but *female*, while *the left testicle and ovary will discharge male instead of female germs.*

How often this anatomical abnormality occurs I am unable to state, since we possess no statistics like those of *Malgaigne* for left-handedness. That this is no mere conjecture of mine may be seen from the fact. that *Virchow* [1]) quotes four cases. where the rudimentary development of the ovaries was combined with congenital abnormalities of the vessels, and more particularly with stenosis.

This abnormality in my opinion *perfectly explains the fact, that the right ovary does not always form male ova nor the left always female:* and it also gives us the explanation, why the foetus does not always occupy the position in the uterus that Hippocrates suggested, even when migration of the ovum has not taken place.

I will also incidentally remark, that such an abnormality in the course of the vessels does not at all require to be always combined with left handedness, for in five families with 23 children which I observed I met with left-handed members in two families, while in the other three none at all.

Objection VII. Since it is a fact beyond all doubt that after extirpation of one or the other ovary children of either sex are born, and of this there are many examples, then my theory. that each ovary contains its own particular or separate ova, must be false.

[1]) Virchow: Chlorose und Endocarditis. Beiträge zur Geburtsh. und Gynäkol. der geburtshilflichen Gesellschaft in Berlin. Vol. 1, p. 369.

To the laity and those of our profession who occupy themselves little or not at all with Gynaecology this objection seems so clear and unequivocal, that absolutely nothing more remains to be said on the matter. But how gynaecological specialists like *Gessner*, *Stratz* and *v. Winkel* declare, that on the ground of the above-mentioned fact, we have presented to us an *absolute* proof of the untenability of my theory, is to me who am no gynaecologist quite unintelligible. I might almost say, that it is with regret, that I find myself compelled in the face of specialists of reputation like v. Winkel to substantiate my theory with facts, which ought to be known to every intelligent doctor even though not a gynaecologist, let alone to specialists. The facts to which I appeal are these:

a. It has been sufficiently proved, that the complete removal of the ovaries is not infrequently extremely difficult, and even impossible.

b. In every ovariotomy a portion of *healthy* or *partially diseased* tissue may quite easily be left behind. The pedicle, as it is called, is itself indeed sometimes nothing more than a sort of artificial product. If the tumour has a broad base or if it pushes a little further in between the two layers of the broad ligament. it is quite possible that when by strong traction a sort of pedicle is made by the formation of a fold in the broad ligament, there is still ovarian tissue to be found in this artificial product. But even with a long pedicle an error may arise, and a part of the cyst wall may be caught in the ligature or the clamp. It is not infrequently, specially noted by operators that the so-called stump still contains small cysts. *Waldeyer* [1]) occasionally found small portions of normal ovarian tissue at the point where the pedicle ran into the wall of the

[1]) Waldeyer: Die epithelialen Eierstockgeschwülste. Archiv für Gynekol. Vol. I, p. 256.

tumour. *In one instance several well preserved corpora lutea could be demonstrated in the neighbourhood of the attachment of the stump. The most positive proof that such portions may be left behind is afforded by those observations, in which after evidently complete removal of an ovarian tumour a new cystic tumour was found to grow upon the same side from the stump or from strong adhesions* [1]).

In extirpation of normal or slightly diseased ovaries too *Hegar* [2]) convinced himself that a portion may be lasily left behind. If we add to this the occurrence of contraction processes adhesions, and difficulties in drawing the ovary into the abdominal wound so that the ligature has to be tied in the abdominal cavity itself, and the organ cut off, then such a thing is still more possible. Besides, the mesenteries of the ovaries in cases of Fibroma, for example, are often so very short that the organ almost rests on the tumour (Hegar: p. 989).

c) It is known from direct anatomical research that even in an advanced stage of cystic disease of the ovary portions of normal parenchyma with Graafian follicles were always found, and moreover pregnancy has been observed after the excision of one ovary although the other grew into a huge tumour after the operation, and in one case numerous punctures had actually taken place [3]).

d. A further source of deception arises in the fact that *it was not an ovarian tumour, that was excised, but one of quite a different kind.* What operation is there that has not been described as an ovariotomy! (Hegar: p. 977).

e. A final source of error is to be found in those cases

[1]) Sp. Wells: Diseases of the Ovaries.

[2]) Hegar: Die Castration der Frauen: Volkmanns Klin. Vorträge.

[3]) Atlee: General and diff. Diagnosis of ovarian tumours. Philad. 1873. Cases 7 and 8.

where *a so-called accessory, or third, ovary exists.* The observations of *Grohe, Klebs* and others permit of no doubt as to the possibility of such a thing.

With these facts which I have taken almost word for word from Hegar [1]), I think I have sufficiently proved that in excision of the ovary mistakes, delusions, and errors occur so frequently, that the birth of children of different sex after the extirpation of one ovary cannot in any way be taken as an *absolute proof* against my theory. If one wanted to draw conclusions like *Gessner, Stratz, v. Winkel* and others, *then one would be bound to come to the quite absurd conclusion*, that the ovaries are absolutely unnecessary for impregnation, since after extirpation of both ovaries pregnancy has often been observed.

In regard to the third ovary one might be readily inclined to regard its occurrence as a phenomenon so rare, that its existence in cases where children of different sexe were born after ovariotomy cannot be taken into account. But that the occurrence of an accessory ovary is by no means a thing of the greatest rarity is shown by the fact, that at the Gynaecological Congress at Munich in 1877 *Beigel* and *v. Winkel* demonstrated preparations of such ovaries, and *Beigel* found them 8 times in 350 post mortem examinations of women. If we consider that one twin pregnancy is reckoned for every 80 single births and that this is not regarded as anything very rare, then the occurrence of accessory ovaries cannot well be counted very uncommon when it is found once in about every 45 cases.

Conclusions.

1. *All theories that rest on a purely statistical, and not on an anatomical-physiological basis have either no value*

[1]) Hegar: Die Castration der Frauen. Volkmanns Sammlung. Klin. Vorträge. No 136—138.

at all, or only a very secondary one in determining the sex of the future child.

2. *Each ovary contains its own particular ova, the right ovary preferably ova for the male sex, the left those for the female.*

3. *Each testicle secretes a seminal fluid, which differs according to the testicle from which it is derived. The semen from the right testicle serves preferably to impregnate male ova, that from the left to impregnate female.*

4. Twins of the same sex spring either from one ovum which possesses two nuclei, or from one follicle which contains two ovula more seldom from one ovum which divides into two, and most seldom of all from two separate ova. In these cases, no matter whether the twins have a common chorion or lie each separate in its own, they develop as the result of one impregnation.

5. Twins of a different sex are derived from ova which have been discharged from different ovaries and can only be the result of superfecundation; it may be that in exceptional cases the seminal fluid was discharged from both testicles simultaneously.

6. Triplets of the same sex are developed from one ovum which contains either three nuclei, or only 2 (and one of these has divided into two), or what is more seldom the case, from three separate ova which however always come from one and the same ovary. Triplets of the same sex are always to be considered as the result of a single impregnation.

7. Triplets that differ in sex come from ova which have been discharged from different ovaries and can only be the result of superfecundation.

Procedure for the Production of a particular sex.

I pass over all the proposals which have been put forward on the basis of statistical theories, partly because they are quite impracticable, partly because no success is to be expected from them, as I think I have proved beyond doubt.

In discussing the theories which rest on an anatomical-physiological basis we saw that many hints had been given, which it is true would be of much use in the rearing of cattle and might also produce practical results, but unfortunately was not applicable to man, as for example the ligature of one or the other testicle.

Since it chiefly depends on the testicle from which the seminal fluid is discharged, pressure could be made on the spermatic cord of the testicle that should not come into action, for example with a truss, or at the moment of emission simply between the fingers. Among such proposals we might include more or less properly the one which *Hippocrates* [1]) gave: —«He (the man) shall bind the right testicle as firmly as he can bear if he wants to beget a girl; if he wishes to beget a boy, then he must bind the left». To this I have to reply. that the pressure on the spermatic cord with a truss necessary to prevent the emission of semen would have to be much too great and would thereby give rise to severe pain, quite apart from the fact that the frequent use of the truss until pregnancy really begins would certainly be followed by bad results.

As regards however *the compression of the spermatic cord* with the fingers shortly before the emission, I am

1) Hippocrates: Superfoetatio. Dexer autem testis quod maxime ferri poterit obligandus, si feminam generare volet: sinister vero si maris procreatio expetetur.

convinced, *that in the large majority of cases that will not be practised, for it is hardly possible to observe the rule, that is laid down at a time, when all rules are usually disregarded and when at the moment of greatest excitement all self-possession ceases.* At the same time it is to be observed, that with the exclusion of the one testicle it is not absolutely necessary that, nay it is very questionable if the other free one will really discharge its semen. Fortunately we require neither ligature nor compression of either the one or the other testicle in order to produce a definite sex; *the discharge of this or that testicle depends simply on the position, which the husband occupies to his wife in bed.*

For the production of a boy, the husband must lie on the right side of his wife, begin the act of coitus from this position, and as far as possible stretch the right side of the upper part of the body in such a way, that the upper part of the trunk lies more to his left, or that his head is supported on the right shoulder of his wife.

For the production of a girl, the husband must lie to the left of his wife, begin the coitus from this side, and take care that the left half of his body lies more to his right and that his head comes to lie on the left shoulder of his wife.

It is of course self-evident, that coitus must be repeated in the very same way, till sure signs of pregnancy appear. Should sexual intercourse be indulged in first in one way and then in another, then it would be practically leaving the matter to chance, since it is impossible to know which act of coitus will be the impregnating one.

Simple as this procedure in itself is, and successful as it is, as is shown by *Couteaux*, *Millot*, *Henke* and the observations which I myself have made in so many families, it is all the more difficult to answer the question as

to the connection which really exists between the position people occupy to each other in bed and the emission of seminal fluid from one particular testicle, or to give a rational proof of the fact, that in a certain position only the one testicle, and not the other, discharges its contents.

I have already mentioned, that it was on purely empirical grounds, that I became convinced, that the sex of the future child in very many cases depends simply on the position which married people occupy to each other, without however finding out the law, by which this fact may be explained. But after I had fought the battle, that is necessary to break away from a universal opinion which was rooted and grounded in me, and had found that each ovary and each testicle produces its own separate germs, I partly took up the view of *Henke* according to which the position is of the greatest significance in so far, that the Cremaster is influenced by the movements which the husband makes in having sexual intercourse.

Henke says, that the Cremaster acts in unison with other muscles, and according as they are more or less relaxed, or contracted more on this or that side, it also is correspondingly directed in its relaxation or contraction (p. 179). The reason, therefore, why the one testicle is raised up before the other, and therefore the seminal fluid is discharged from only one vesicula seminalis, may always lie in an accidental movement of the great neighbouring muscles and their influence on the Cremaster, and in so far as this movement is accidental, the production of male children may, nay must also be accidental, but it ceases to be so as soon as one knows how to direct the movement of these muscles and the Cremaster.

Since it is proved beyond doubt, that the Cremaster draws up the testicle to the inguinal canal, and by the

pressure, which it makes on the testicle facilitates the transmission of the seminal fluid, which rises up in the vas deferens against gravity, it cannot be denied, that much is to be said for the explanation which *Henke* gave for the influence of the position on the action of the Cremaster.

According to the facts of expirience and the many communications that I have collected, the movement necessary to obtain coitus is alone in reality sufficient to raise up the suitable testicle before emission. Everyone can thoroughly convince himself of the fact that every time complete erection sets in, only one testicle is drawn up to, or into, the inguinal ring, so that a purely reflex action appears to take place, and it is well known that the Cremaster replies to irritation with remarkable reflex movements—that testicle is at once raised up. From this fact, *that only one testicle is always raised up. we are entitled to conclude*, that seminal fluid it also ejected *from this testicle alone.*

According to *Millot* the position has an influence on the determination of the sex in so far as the wife by a moderate inclination of her pelvis to the side on which the ovary that it is wished to impregnate lies can direct the seminal fluid to the same side: this however I consider as most highly improbable. On the other hand it cannot be denied that much is to be said for the theory proposed by *Roth* [1]) (p. 155 of this treatise), according to which the mechanical pressing inwards and irritation of the one side of the external genitals is transmitted through the pudic nerve by means of the hypogastric plexus to the corresponding half of the genital canal and the uterus along with the fallopian tube and ovary of that side.

[1]) Roth: Ueber die Bestimmung des Geschlechts. Deutsche Med. Zeitung. 1884. № 26.

Now whatever other causes there may be, which affect the emission of semen from this or that testicle, this much is clear to me, that a large number of facts, which I have met with in my own practice and which *Millot*, *Roth*, and others have collected together, has convinced me that *the position of husband and wife to one another is of the greatest importance in the determination of the sex.* Every man who has had children is at once in a position to acknowledge or to refute the correctness of this method; and this will be all the more easy for the man who has begotten only boys or only girls.

Expressions of gratitude and approval in great numbers have been sent to me by the laity, and if they are really not without significance, I yet place a much higher worth on the letters that have come to me from many colleagues of which (besides the one already quoted in p. 129) I append two more because the one put briefly and the other in extenso look upon the procedure which I have described as the right one, and the other letters are more or less in exactly the same strain.

W... 1/XI, 189*.

A. Your Excellency.

Having devoted myself to the study of the question of the production of children according to choice, I read your book (German edition) some time ago. I was *at once much surprised* and *rejoiced* at the original way, in which your Excellency refuted the various views that exist on the subject, but most especially at the proposal, which was made in the last chapter. *I have already applied the prescribed method repeatedly in my gynaecological practice* (of course not a very large one) *and in every case I found it borne out most* remarkably. Having become through these results a warm supporter of your theory etc.

Dr. K*.

B. Honourable Sir,

With regard to p. VI of your Monograph on the determination of sex (German edition) I take the liberty to ask you whether the experiments on animals quoted on pages (84—86) are concluded and to what results they have led.

I must profess myself a staunch supporter of your theory of the production of sex, and even before reading your highly interesting scientific work I had had *a notion that each testicle and ovary must have its own definite action in the determination of the sex.* For a long time I have castrated cows that were always in heat, and in the case of one cow, for example, I observed that the one ovary had undergone so great cystic changes that there was not a trace of normal tissue in it, while *the left ovary* showed no pathological signs. What was the result? This cow had up to the time of the operation *thrown only cow-calves* (twice); I observed exactly the opposite in another case where the cow, whose left ovary was completely cystic, had brought forth a bull-calf and is said to have before that aborted a male foetus at the 6-th month of gestation. In litter-bearing animals I have been as yet unfortunately unable to make any special observations, but as soon as opportunity offers I will further pursue the question of the production of sex on experimental lines.

Lastly, I am in a position to confirm *from my own family* the fact about the production of boys and girls, which you state on p. 105. I have one girl and three boys, *and I happen to know these boys were all begotten from my lying on the right of my wife and beginning our sexual intercourse from that side: I am perfectly deaf on the right ear, and in order not to let this interfere with our conversation in bed I lay on the right side of my wife, so that my normal (left) ear might be turned*

towards her; at the time of the conception of the girl our position in bed was in consequence of a change in our residence accidentally altered, so that for some time I slept contrary to my custom on the left side of my wife

This is the real truth of my observation.

K*. District Vety. Inspector.

It is a matter of course that here too the maxim that there is no rule without exception holds good, and I do not maintain that by having regard to the position one must always produce the desired result. I have rather shown, that such exceptions were seen in five families with 23 children in that, when the husband lay on the right side of the wife girls were produced, and when on the left, boys were begotten. These exceptions, however, were also so far a proof that each testicle and ovary contains its own particular germs in that *the position was of such importance for the determination of sex that in their case too the change of the position at once produced a change in the sex.*

It is therefore impossible to get rid of the fact that *the proposed method, drawn as it is from life, is one, which up till, now may be counted upon with a probability bordering upon certainty for the production of a particular sex.*

Although I anticipate that my views on the determination of sex will meet with much opposition, yet I know, that in every branch of Science, and more especially in that of medicine many facts take often years, nay even centuries, before they are admitted: for unfortunately it is with reluctance that an opinion once embraced is given up by every person, and often by the scientist most of all.

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